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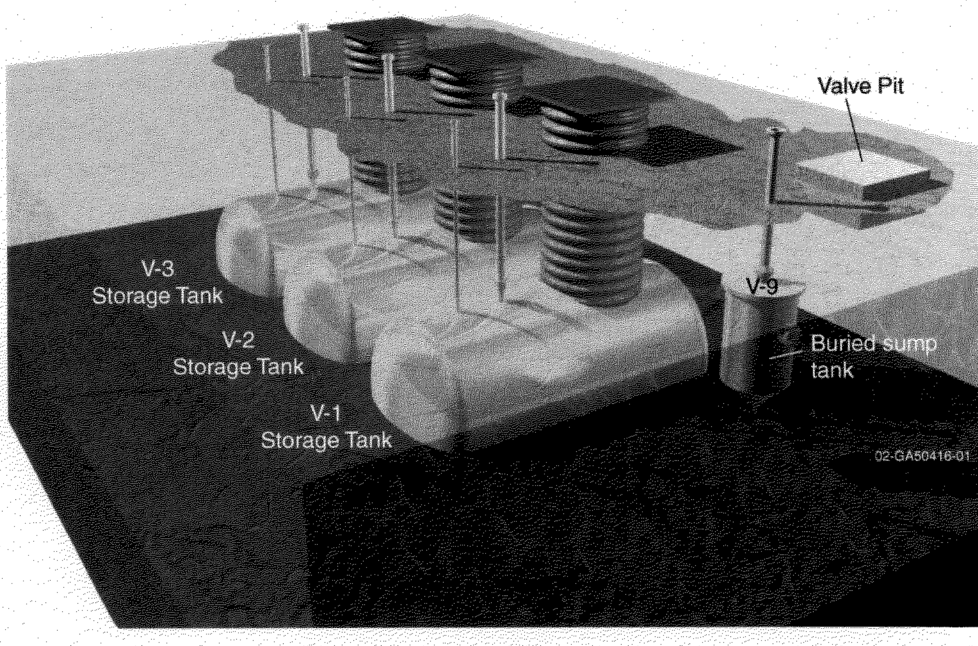
Project No. 22901

U.S. Department of Energy
Idaho Operations Office

Technology Evaluation Report for the V-Tanks, TSF-09/18, at Waste Area Group 1, Operable Unit 1-10



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Approved by

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ABSTRACT

This Technology Evaluation Report summarizes the decision analysis process and data used to select a preferred alternative for remedial action of the V-Tanks at the Idaho National Engineering and Environmental Laboratory. The V-Tanks consist of four underground storage tanks that contain sludge and liquid remaining from Test Area North operations between the 1950s and 1980s. The sludge contains a variety of constituents, including radionuclides (such as Cesium-137, Strontium-90, transuranics, and uranium), organics (such as trichloroethane, tetrachloroethane, and polychlorinated biphenyls), and inorganics (such as mercury, cadmium, and lead). In addition to the tank contents, the surrounding soil has been contaminated from spills that occurred while the liquid waste treatment system was operating.

Three technologies were evaluated for treatment of the V-Tank contents: (1) vitrification, (2) thermal desorption, and (3) chemical oxidation/reduction followed by stabilization. Within each technology, alternatives such as in situ, ex situ, and on-Site and off-Site treatment and disposal were considered. Preconceptual designs were completed for each alternative. These designs focused primarily on the threshold criteria of protection of human health and the environment and compliance with applicable or relevant and appropriate requirements under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). To address the balancing criteria that CERCLA outlines, a V-Tanks Decision Support Model was used as an aid in the decision-making process.

From these studies, evaluations, and discussions, ex situ chemical oxidation/reduction followed by stabilization was selected by the Agencies as the preferred alternative for treatment of the V-Tanks' contents. This alternative will remove tank contents and use a chemical oxidant to destroy the organic compounds to below land disposal restriction limits. Then, the waste will be stabilized in containers and disposed of at the INEEL CERCLA Disposal Facility (ICDF). Finally, the surrounding soil, tanks, and debris will be removed and disposed of at the ICDF.

This preferred alternative—ex situ chemical oxidation/reduction followed by stabilization—will be identified in a proposed plan and issued for public input where the two remaining CERCLA criteria of state and community acceptance will be addressed.

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FIGURES

TABLES

ACRONYMS

ARA	Auxiliary Reactor Area
ARAR	applicable or relevant and appropriate requirement
ATG	Allied Technology Group
BEHP	bis(2-ethylhexyl)phthalate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CFT	contaminant for treatment
CO/S	chemical oxidation/reduction with stabilization
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
DRE	destruction and removal efficiency
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ES-CO/S	ex situ chemical oxidation/reduction followed by stabilization
ESV	ex situ vitrification
FY	fiscal year
GAC	granular-activated carbon
HEPA	high-efficiency particulate air
ICDF	INEEL CERCLA Disposal Facility
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IS-CO/S	in situ chemical oxidation/reduction followed by stabilization

ISV	in situ vitrification
LDR	land disposal restriction
LMITCO	Lockheed Martin Idaho Technologies Company
MACT	maximum achievable control technology
NTS	Nevada Test Site
OR	operational readiness
OU	operable unit
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
PFD	process flow diagram
PPE	personal protective equipment
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RMERC	roasting or retorting mercury
ROD	Record of Decision
RWMC	Radioactive Waste Management Complex
SD	safety documentation
SGAC	sulfur-impregnated granular-activated carbon
SVOC	semivolatile organic compound
TAN	Test Area North
TCA	trichloroethane
TCE	trichloroethylene
TCLP	toxicity characteristic leaching procedure
TD	thermal desorption
TMV	toxicity, mobility, or volume
TO	thermal oxidizer

TRU	transuranic
TS&D	treatment, storage, and disposal
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility
TSF	Technical Support Facility
UTS	universal treatment standard
USC	United States Code
VOC	volatile organic compound
WIPP	Waste Isolation Pilot Plant

1. INTRODUCTION

This Technology Evaluation Report summarizes the results of the technology evaluation and comparative analysis processes used to select a new preferred alternative for the V-Tanks' remedial action at Test Area North (TAN), which is one of 10 primary facility areas at the Idaho National Engineering and Environmental Laboratory (INEEL). The three Agencies—the U.S. Department of Energy Idaho Operations Office (DOE-ID), the Idaho Department of Environmental Quality (IDEQ), and the U.S. Environmental Protection Agency (EPA)—decided to evaluate these technologies as replacements for the current alternative in the *Final Record of Decision for Test Area North, Operable Unit 1-10* (DOE-ID 1999a). The current Record of Decision (ROD) alternative is no longer viable, because the off-Site facility capable of treating the waste is no longer available. There is no other facility capable of treating the designated waste stream in accordance with the current ROD alternative.

Three technologies were evaluated:

- Vitrification
  - In situ vitrification (ISV)
  - Ex situ vitrification (ESV)
- Thermal desorption (TD)
  - On-Site desorption with off-Site treatment of off-gas residuals (TD on/off-Site)
  - On-Site desorption with direct treatment of off-gas residuals (TD on-Site)
  - On-Site desorption with off-Site disposal of concentrated solids and off-Site treatment of off-gas residuals (TD off-Site)
- Chemical oxidation/reduction with stabilization (CO/S)
  - In situ chemical oxidation/reduction followed by stabilization (IS-CO/S)
  - Ex situ chemical oxidation/reduction followed by stabilization (ES-CO/S).

The technology evaluation process was performed in accordance with the *Technology Evaluation Scope of Work for the V-Tanks, TSF-09/18, at Waste Area Group 1, Operable Unit 1-10* (DOE-ID 2002a). The technologies evaluated in this report for treating V-Tank waste are vitrification, thermal desorption (TD), and chemical oxidation/reduction stabilization (CO/S). This report provides a comparative analysis of the alternatives against the criteria in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC § 9601 et seq.). It selects a preferred alternative to be presented in a new proposed plan. Following public comment on the proposed plan, a new remedy for the V-Tanks will be selected and presented in a ROD amendment. Detailed information about the technology alternatives can be found in the following report: *Pre-Conceptual Designs of Various Alternatives for the V-Tanks, TSF-09/18 at Waste Area Group 1 Operable Unit 1-10* (INEEL 2002a).

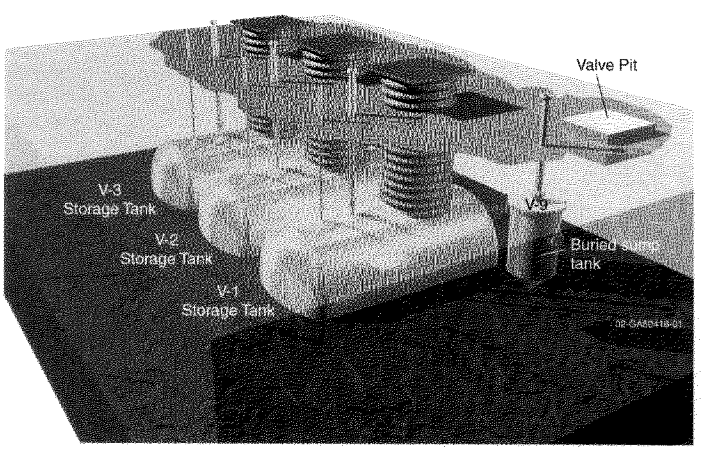

Figure 1. V-Tank configuration.

The V-Tanks discussed in this document are four underground stainless-steel tanks (see Figure 1) installed at the TAN Technical Support Facility (TSF) in the early 1950s as part of a system designed to collect and treat radioactive liquid effluents from TAN operations. These four tanks are identified as Tanks V-1, V-2, V-3, and V-9 and do not have secondary containment. Each of the V-Tanks contains a liquid layer and a sludge layer. The tops of Tanks V-1, V-2, and V-3 (designated as Site TSF-09) are approximately 10 ft below the ground surface (see Figure 2), while the top of Tank V-9 (designated as Site TSF-18) is 7 ft below the ground surface (see Figure 3). The primary focus of the remedial action discussed in this technical report is the treatment and disposal of the tanks' contents. Table 1 summarizes the tanks' capacities and contents.

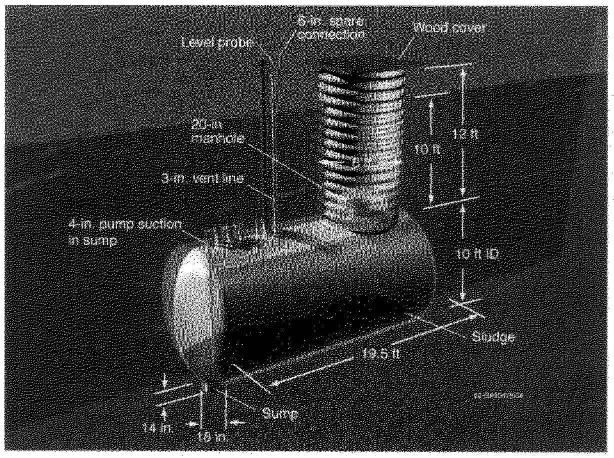

Figure 2. Tanks V-1, V-2, and V-3.

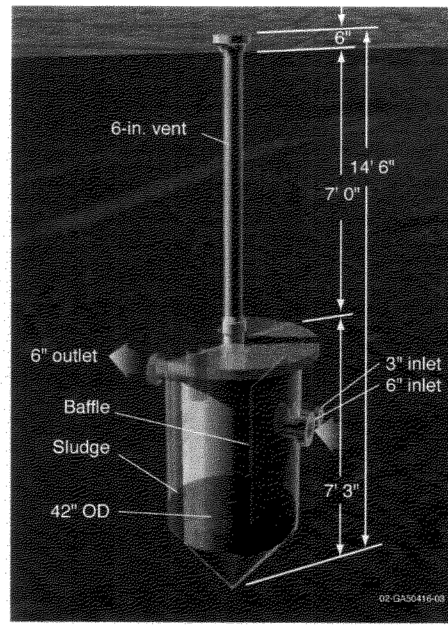

Figure 3. Tank V-9.

Table 1. V-Tank volume in gallons.

Tank	Capacity	Liquid Volume	Sludge Volume	Total Volume
V-1	10,000	1,164	520	1,684
V-2	10,000	1,138	458	1,596
V-3	10,000	7,660	652	8,312
V-9	400	70	250	320
Total	30,400	10,032	1,880	11,912

Remediation of these tanks is an essential element of the INEEL Accelerated Cleanup Project to clean up and close U.S. Department of Energy (DOE) Environmental Management facilities at the INEEL.

The design for the original V-Tanks' remedy in the *Comprehensive Remedial Design/Remedial Action Work Plan for the Test Area North, Waste Area Group 1, Operable Unit 1-10, Group 2 Sites* (DOE-ID 2001) included treating each phase, liquid and sludge, separately. The remedy design included removing and shipping the tank contents to the Allied Technology Group (ATG), which is an out-of-state commercial treatment (vitrification) facility. However, the facility is no longer available. This made it necessary for the Agencies to consider other treatment alternatives using a focused feasibility study. The alternatives discussed in this report were chosen for evaluation based on a screening level analysis, as discussed in Section 2 of this report. The specific alternatives chosen were:

on-Site = on the INEEL site
off-Site = off the INEEL site

- Vitrification
  - In situ vitrification (ISV)
  - Ex situ vitrification (ESV)
- Thermal desorption
  - On-Site desorption with off-Site treatment of off-gas residuals (TD on/off-Site)
  - On-Site desorption with direct treatment of off-gas residuals (TD on-Site)
  - On-Site desorption with off-Site disposal of concentrated solids and off-Site treatment of off-gas residuals (TD off-Site)
- Chemical oxidation/reduction with stabilization
  - In situ chemical oxidation/reduction followed by stabilization (IS-CO/S)
  - Ex situ chemical oxidation/reduction followed by stabilization (ES-CO/S).

1.1 Contaminants of Concern and Contaminants for Treatment

The original ROD identifies Cs-137 as the only contaminant of concern for the V-Tanks site. However, the INEEL, in conjunction with the regulating agencies, developed a list of contaminants for treatment (CFTs) in order to analyze the chosen alternatives. These CFTs are based on treatment and disposal requirements in accordance with the Resource Conservation and Recovery Act (RCRA) (42 USC § 6901 et seq.) and the waste acceptance criteria of the selected disposal facility(ies). The list of CFTs is presented in Table 2. A detailed discussion of these CFTs relative to the technologies evaluated is provided in the Pre-Conceptual Designs Report (INEEL 2002a).

Table 2. V-Tank contaminants for treatment.

V-Tank Contaminants for Treatment	
Inorganics	**Volatile Organic Compounds**
Antimony (Sb)	Tetrachloroethylene (PCE)
Arsenic (As)	1, 1, 1—Trichloroethane
Barium (Ba)	Trichloroethylene
Beryllium (Be)	
Cadmium (Cd)	**Semivolatile Organic Compounds**
Chlorides (Cl)	bis (2-ethylhexyl) phthalate
Chromium (Cr)	Polychlorinated biphenyls
Lead (Pb)	
Mercury (Hg)	**Radionuclides**
Nickel (Ni)	Cesium (Cs-137)
Silver (Ag)	Strontium (Sr-90)
	Transuranics[a]

a. Includes plutonium (Pu-238 and Pu-239/240), americium (Am-241), curium (Cm-243/244), and neptunium (Np-237).

Table 3 provides the composition of each V-Tank and the overall weighted average for each CFT, as well as other major constituents. Table 3 also includes two columns under the "Tank V-3" and "Average" tank concentration headings. One column under each of these headings provides information about current V-3 and average tank concentrations, while the other column under each of these headings provides V-3 and average tank concentrations after 6,000 gal of supernatant has been removed from Tank V-3.

The mass balances described and referenced in these reports are based on the assumption that 6,000 gal of liquid supernatant was removed from Tank V-3 before initiating the various technologies. However, removal of this liquid might not be completed if the preferred alternative is ultimately selected. The impact on the comparative analysis is inconsequential with or without removal of this liquid.

1.2 Assumptions

The assumptions that have been used for the technology evaluation and comparative analysis that are addressed in this report are listed in Section 1.2.1. In addition, Section 1.2.2 lists the assumptions for treatment.

1.2.1 Characterization Assumptions for the V-Tank Waste Contents

The following are characterization assumptions for the V-Tank waste contents:

- Waste in the V-Tanks has undergone previous RCRA characterization. The V-Tank contents are characterized as RCRA code F001, due to the spent halogenated solvent (trichloroethylene [TCE]) used in degreasing during TAN operations.

- The V-Tank waste is characteristically hazardous, which invokes the full list of underlying hazardous constituents. Therefore, for example, polychlorinated biphenyls (PCBs) require treatment to the 10-ppm land disposal restriction (LDR) limit, and bis(2-ethylhexyl)phthalate (BEHP) requires treatment to the 28-ppm LDR limit for disposal of the primary waste form at the INEEL CERCLA Disposal Facility (ICDF).

- All secondary waste from each treatment alternative will be characterized as F001 listed due to the "derived-from" rule.

- Primary and secondary waste (F001 listed) that meets LDRs will be considered for disposal at the ICDF.

- Secondary waste (F001 listed) that does not meet LDRs and that cannot be practically treated on-Site, in accordance with the treatment alternative mass balances (see Section 3), will be sent off-Site for treatment and/or disposal.

1.2.2 Assumptions for Treatment

The following are treatment assumptions:

- For comparative analysis purposes, all proposed remediation technologies will be initiated after 6,000 gal of liquid supernatant has been removed from Tank V-3.

- The ICDF will open in July 2003 and will be available to receive V-Tank waste in 2005, when the remedial action is projected to take place.

- The Agencies will approve the applicable or relevant and appropriate requirements (ARARs) associated with RCRA alternative treatment standards and Toxic Substances Control Act (TSCA) risk-based petitions (see Section 5.2).

- Design and treatment operations will be performed to meet "clean closure" requirements.

- The ATG will remain a nonviable alternative for treatment of the V-Tanks' waste. No other off-Site treatment will be available before 2005.

- Delisting of the V-Tank contents as hazardous waste will not be pursued.

- The Nevada Test Site (NTS) or Hanford will be accepting out-of-state mixed waste for treatment/disposal by 2007.

- The Waste Isolation Pilot Plant (WIPP) will be accepting remote-handled waste by 2007.

- Soil additions for various treatment alternatives (e.g., vitrification and thermal desorption) are acceptable to ensure proper process operations.

- Thermal desorption is approved by the EPA as a type of retort.

- Macroencapsulation can be performed on those off-gas units that are not granular in form (such as high-efficiency particulate air [HEPA] filters), provided other waste acceptance criteria are met (e.g., less than 500 ppm total organic carbon for the ICDF).

- Macroencapsulation cannot be performed on those off-gas units that are granular in form (such as granular-activated carbon [GAC] and sulfur-impregnated granular-activated carbon [SGAC] filters). As a result, they can only be disposed of at the ICDF if they meet LDRs.

- Organic destruction efficiencies demonstrated during treatability studies (INEEL 1998) will be achieved during actual chemical oxidation/reduction of V-Tank waste.

- V-Tank waste is considered a single waste stream for the purposes of establishing necessary treatment requirements.

- TAN-616 will be removed down to its foundation by the time remediation is initiated.

- Buildings surrounding TSF-09 and TSF-18[a] (other than TAN-616) will not be affected by the remedial action and removal of TAN-616.

- The contents of all four V-Tanks can be slurried and removed without additional liquid.

- Equipment for transferring the slurried V-Tank sludge and liquid phases will require temporary shielding and secondary containment. Equipment used for decanting V-Tank liquid, before slurrying, only requires secondary containment.

- Maximum achievable control technology (MACT) emission standards only apply to the off-gas treatment system used for the vitrification and thermal desorption on-Site alternatives.

- Contamination control during excavation of contaminated soil can be managed by maintaining slightly damp soil conditions, placing wind restrictions on operations, using temporary tarps, etc., as opposed to large temporary containment structures.

- All equipment coming in contact with the waste or its residuals during processing might have to be disposed of at the ICDF as debris. However, an effort will be made to recover or reuse as much of this equipment as possible before disposing of it as debris waste.

a. Tanks V-1, V-2, and V-3 have an Operable Unit 1-10 CERCLA Site identifier of TSF-09, while Tank V-9 has the identifier of TSF-18.

Table 3. Major components and contaminants for treatment (concentration mg/kg or nCi/g).

Component	Tank V-1	Tank V-2	Tank V-3 As Is	Tank V-3 6,000 gal of Liquid Removed	Tank V-9	Average As Is	Average[a] 6,000 gal of Liquid Removed
Inorganics							
Aluminum (Al)	5.27E+02	1.12E+03	2.58E+02	9.23E+02	2.69E+03	4.82E+02	9.67E+02
Antimony (Sb)	5.13E+00	5.35E+00	9.57E-01	3.43E+00	1.15E+01	2.44E+00	4.90E+00
Arsenic (As)	3.00E+00	3.45E+00	8.58E-01	3.08E+00	3.05E+00	1.48E+00	3.15E+00
Barium (Ba)	4.33E+01	3.80E+01	1.15E+01	4.13E+01	2.99E+02	2.79E+01	5.62E+01
Beryllium (Be)	8.31E+00	4.24E+00	1.49E+00	5.33E+00	2.02E+01	3.36E+00	6.75E+00
Cadmium (Cd)	2.02E+01	2.27E+01	5.09E+00	1.82E+01	2.18E+01	1.01E+01	2.02E+01
Calcium (Ca)	1.78E+03	2.24E+03	6.90E+02	2.34E+03	6.75E+03	1.23E+03	2.42E+03
Chlorides (Cl)[b]	2.08E+02	1.02E+02	7.42E+01	6.90E+01	3.97E+02	1.06E+02	1.36E+02
Chromium (Cr)	5.26E+02	1.12E+03	2.58E+01	9.23E+01	1.88E+03	2.97E+02	5.96E+02
Iron (Fe)	2.63E+03	5.58E+03	1.61E+03	5.77E+03	1.46E+04	2.67E+03	5.35E+03
Lead (Pb)	2.55E+02	3.03E+02	7.27E+01	2.60E+02	4.54E+02	1.41E+02	2.82E+02
Magnesium (Mg)	2.64E+03	2.24E+03	9.81E+02	3.47E+03	9.01E+03	1.62E+03	3.23E+03
Manganese (Mn)	7.02E+02	2.23E+03	3.23E+02	1.15E+03	4.27E+03	7.48E+02	1.50E+03
Mercury (Hg)	2.05E+02	1.16E+02	5.16E+01	1.85E+02	1.67E+03	1.29E+02	2.59E+02
Nickel (Ni)	8.14E+01	7.60E+01	2.39E+01	8.52E+01	3.19E+02	4.77E+01	9.54E+01
Phosphorous (P)	9.63E+03	1.34E+04	4.19E+03	1.50E+04	4.04E+04	7.26E+03	1.45E+04
Silicon (Si)	2.10E+04	2.23E+04	6.13E+03	2.19E+04	7.07E+04	1.23E+04	2.46E+04
Silver (Ag)	3.52E+01	5.05E+01	6.96E+00	2.49E+01	5.22E+02	3.19E+01	6.39E+01
Zinc (Zn)	4.46E+03	4.17E+02	3.74E+02	1.34E+03	1.41E+03	9.87E+02	1.98E+03
VOCs							
PCE	4.38E+02	1.38E+02	3.63E+01	1.30E+02	4.25E+02	1.18E+02	2.37E+02

Table 3. (continued).

Component	Tank V-1	Tank V-2	Tank V-3 As Is	Tank V-3 6,000 gal of Liquid Removed	Tank V-9	Average As Is	Average[a] 6,000 gal of Liquid Removed
TCA	3.14E-01	1.56E-01	4.90E-02	1.59E-01	1.77E+03	5.22E+01	1.05E+02
TCE	3.85E+00	3.62E-01	2.34E-01	2.95E-01	1.45E+04	4.26E+02	8.54E+02
SVOCs							
BEHP	9.19E+02	5.86E+02	3.38E+02	1.21E+03	3.45E+02	4.54E+02	9.10E+02
Aroclor-1260	3.46E+01	2.44E+01	9.99E+00	3.58E+01	9.59E+01	1.79E+01	3.59E+01
Radionuclides							
Cs-137 (nCi/g)	1.74E+03	1.81E+03	5.28E+02	1.88E+03	4.48E+03	9.88E+02	1.98E+03
Sr-90 (nCi/g)	1.52E+03	3.20E+03	1.51E+03	5.36E+03	5.18E+03	1.84E+03	3.68E+03
Transuranics (nCi/g)	1.10E+01	4.02E+00	2.03E+00	7.29E+00	2.64E+01	4.27E+00	8.57E+00
Other							
Total Carbon[c]	1.67E+04	3.33E+04	7.99E+03	2.85E+04	9.19E+03	1.27E+04	2.53E+04

a. Average concentrations are calculated using a weighted average based on tank mass.
b. Does not include chlorides from organics.
c. Assumed to be organic carbon.
BEHP = bis(2-ethylhexl)phthalate
PCE = tetrachloroethylene
SVOC = semivolatile organic compound
TCA = trichloroethane
TCE = trichloroethylene
VOC = volatile organic compound

1.3 Remedial Action Objectives

The remedial action objectives (RAOs) identified in the Operable Unit (OU) 1-10 ROD (DOE-ID 1999a) remain in effect. The RAOs were based on the baseline risk assessment in the *Comprehensive Remedial Investigation/Feasibility Study for the Test Area North Operable Unit 1-10 at the Idaho National Engineering and Environmental Laboratory* (DOE-ID 1997). The RAOs for the V-Tanks and surrounding soil remain applicable and include the following:

- Reduce risk from external radiation exposure from Cs-137 to a total excess cancer risk of less than 1 in 10,000 for the hypothetical resident 100 years in the future and the current and future worker
- Prevent release of the V-Tank contents to the environment.

1.4 Remedial Performance Objectives

Remedy performance objectives were developed during the original remedy design to augment and support the RAOs identified in the OU 1-10 ROD (DOE-ID 1999a). These remedy performance objectives were developed based on the original design approach in the OU 1-10 Remedial Design/Remedial Action Work Plan (DOE-ID 2001) and the OU 1-10 ROD requirement to close the site under the State of Idaho "Hazardous Waste Management Act" (Idaho Code § 39-4401 et seq.). The remedy performance objectives identified in the original design remain applicable to the technologies evaluated and include the following:

- Remove the tank contents, tanks, and ancillary lines/equipment
- Remove the components within the site managed under the Voluntary Consent Order
- Characterize the base of the excavations to determine if releases to the environment from the tanks, piping, and ancillary equipment have occurred
- Characterize the nature and extent of soil contamination in the area surrounding the V-Tanks
- Remove contaminated soil above the final remediation goal for Cs-137 (23.3 pCi/g)
- Remove RCRA-hazardous constituents above regulatory limits to facilitate RCRA closure
- Characterize, treat (as required), and dispose of the generated waste.

1.5 Technical and Functional Requirements

A global set of preliminary technical and functional requirements was developed and is applicable to all of the alternatives for processing V-Tank waste. They provide an overview of some of the key requirements that guided the preconceptual design process. The primary waste form refers to the final, treated form of the bulk V-Tank solids (for vitrification and TD) and the combined solids and liquids for CO/S. Specifically, this is the glassified waste form for vitrification, the bottoms residue from the TD unit (after stabilization, if required), and the stabilized (grouted) waste form for CO/S. These technical and functional requirements are summarized as follows:

- Components of the treatment system shall have real-time monitoring capability (pressure, flow, etc.).

- The treatment system shall be capable of operation with available electrical power sources at TAN, or a suitable portable generator shall be provided.
- The treatment system shall have process data collection and storage capability.
- The treatment system shall be capable of removing or immobilizing hazardous constituents such that the final primary waste form meets, or can be treated to meet, Treatment, Storage, and Disposal Facility (TSDF) criteria.
- The treatment system shall be capable of direct or remote operation, as required by radiation levels, and designed to as low as reasonably achievable requirements.
- The treatment system shall have secondary containment, as required by RCRA (42 USC § 6901 et seq.) and shall meet other applicable industrial standards.
- Radiation shielding shall be used (as required) for all waste transfer subsystems, and remote- or semiremote-operating methods will be needed for the transfers. Particular design considerations will be necessary for transferring dry solids to mitigate escape of contaminated fine particles. Grout and waste stabilization systems will require similar design considerations.
- Process streams shall be compatible with the existing V-Tanks or new treatment system components for the maximum estimated duration of the operation.
- Operating personnel and the environment shall be protected against industrial and radiological hazards.
- Suitable on-Site interim storage shall be provided for primary and secondary waste before further treatment or disposal.

1.6 Technology Evaluation Process

1.6.1 History of the V-Tanks' Decision Support Model

In 2000, a methodology for modeling, structuring, scoring, and evaluating remedial alternatives for CERCLA sites (in general) was developed—*INEEL Subsurface Disposal Area CERCLA-Based Technology Screening Model* (INEEL 2000). A decision was made to modify the existing model to be specific to the V-Tanks. First, criteria, subcriteria, and metrics were determined based on EPA CERCLA guidance, the contaminants of concern and CFTs, and the unique challenges of the site. Next, each criterion was weighted according to the importance established by the three Agencies. The resultant V-Tanks' decision support model comprises evaluation measures, value functions, criteria weights, and a mathematical method for scoring each remedial alternative to obtain a quantitative and consistent comparison against CERCLA criteria.

This model was validated with State of Idaho and EPA regulators as well as the DOE-ID. The model uses net present value cost data, implementation data, and performance data to compare remedial alternatives. The method can easily incorporate analysis of key site characterization and performance uncertainties. As new technology effectiveness and cost data become available, the decision support model can be updated periodically to provide remedial alternative evaluation products to DOE-ID, IDEQ, and EPA decision-makers to support key decision milestones.

1.6.2 Technology Evaluation Process

Figure 4 illustrates an overview of the process used for this evaluation and shows how the process will proceed from this point forward. The process had to be altered slightly from that presented in the Technology Evaluation Scope of Work (DOE-ID 2002a) due to the lack of conceptual design information available from vendors. As a result, Bechtel BWXT Idaho, LLC, generated preconceptual designs for the alternatives. These designs were guided by the global technical and functional requirements and RAOs listed in Section 1.3, "Remedial Action Objectives," and Section 1.5, "Technical and Functional Requirements." The designs included process flow diagrams (PFDs) and associated mass balances in sufficient detail to allow development of an approximate schedule and a preconceptual cost estimate (+50%, -30%). The cost estimates consider all pertinent costs (those associated with Remedial Design/Remedial Action Work Plan issuance, waste disposal, historical costs, transportation, etc.) to ensure a comprehensive life-cycle estimate.

Mass balances for the primary and secondary waste streams were developed to ensure compliance with the associated TSDFs' requirements. Sufficient information was developed to evaluate the various technology alternatives relative to the CERCLA criteria. The V-Tanks' decision support model was used to facilitate objective selection of the preferred alternative, as described in Section 5, "Preferred Alternative Presentation and Remedy Selection." The preconceptual design alternatives are described in detail in the following report: *Pre-Conceptual Designs of Various Alternatives for the V-Tanks, TSF-09/18 at Waste Area Group 1 Operable Unit 1-10* (INEEL 2002a).

1.6.3 Technology Evaluation Supporting Documents

The documents that directly support the information presented in this report include:

- *Technology Evaluation Scope of Work for the V-Tanks, TSF-09/18, at Waste Area Group 1, Operable Unit 1-10* (DOE-ID 2002a)—This document provides the initial screening of technologies to be evaluated and the technology evaluation process outline.
- *Pre-Conceptual Designs of Various Alternatives for the V-Tanks, TSF-09/18 at Waste Area Group 1 Operable Unit 1-10* (INEEL 2002a)—This document provides the preconceptual designs for each technology alternative addressed in this report.

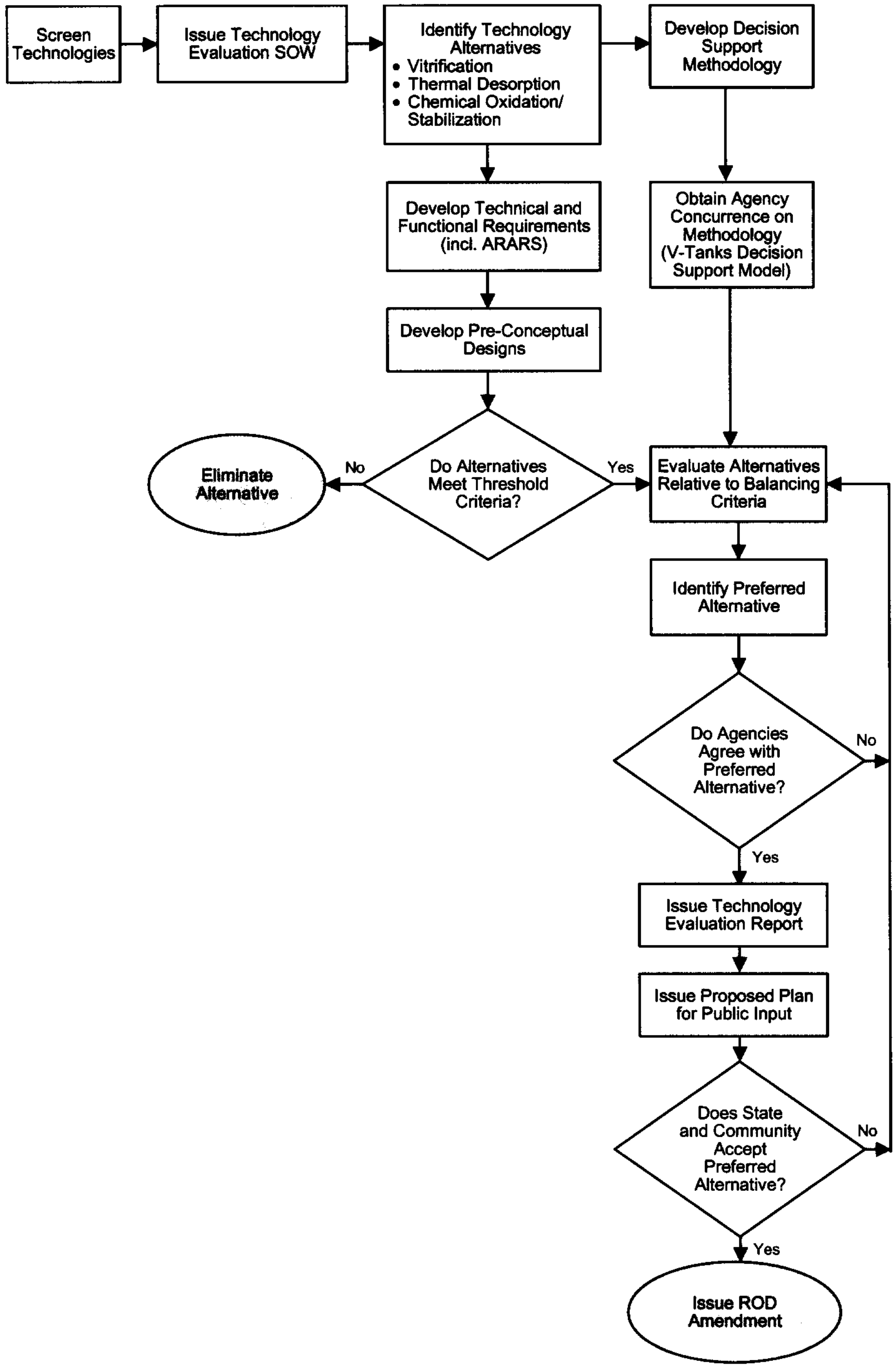

Figure 4. Technology evaluation process flow diagram.

2. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

Since the specified ROD remedy for the V-Tanks (DOE-ID 1999a) was not executable as planned, a reanalysis of viable alternatives was undertaken. The technology evaluation focused on currently viable technologies. Initial screening of technologies is described in the Technology Evaluation Scope of Work (DOE-ID 2002a). To be thorough, technologies previously considered in the Remedial Investigation/Feasibility Study (DOE-ID 1997) also were reviewed, and all technologies that were considered previously or during the current technology evaluation are discussed below.

As described in Section 1, the V-Tanks' contents represent a complex waste stream. This complexity might require use of multiple treatment technologies to ensure that all of the hazardous constituents are properly treated before disposal. In addition to this screening level analysis, the Technology Evaluation Scope of Work (DOE-ID 2002a) outlined various resources and previous evaluations that helped narrow the field of potentially viable technologies.

2.1 No Action

The No Action alternative does not include remedial activities beyond Site access controls and/or environmental monitoring currently conducted at the INEEL as part of Sitewide activities. The No Action alternative does not achieve the RAOs for the V-Tanks, and it was previously excluded. No further discussion of this alternative is provided.

2.2 Institutional Controls

Institutional controls include actions taken by the responsible authorities to minimize potential danger to human health and the environment. Institutional controls are ongoing actions that can be maintained only for as long as the responsible authority is in control of the site. Based on the *Comprehensive Facility and Land Use Plan* (DOE-ID 1996), institutional controls will be maintained for a minimum of 100 years following site closure. While institutional controls may be used to supplement other remedial actions, the RAOs are not achieved solely through these controls. In addition, if current RAOs are achieved, it is expected that institutional controls may not be required. Institutional controls are currently in place for the V-Tanks site, and they will be retained for further consideration (if required) after completion of the remedial action.

2.3 Containment

Containment options for the V-Tanks' contents include capping the tank areas and installing hydraulic barriers. These options are discussed in Sections 2.3.1 and 2.3.2.

2.3.1 Capping

A cap installed above the tank location serves to deter inadvertent intrusion into the tanks or erosion of existing cover materials, and it prevents percolation of precipitation, which could mobilize contaminants in the event the V-Tanks leak. This technology does not eliminate horizontal or downward migration of contaminants from tank leakage. Capping was eliminated from further consideration due to its limited effectiveness in preventing releases of contaminants from the V-Tanks.

2.3.2 Hydraulic Barriers

Horizontal and downward migration of contaminants can be mitigated by installing hydraulic barriers. Hydraulic barrier costs are high, and they could ultimately leak. In addition, the cell created around the V-Tank by the installed barriers could fill with precipitation, which could bring contaminants to the ground surface, unless capped as well. Hydraulic barriers were eliminated from further consideration due to the potential lack of long-term effectiveness and high cost.

2.4 In Situ Treatment

2.4.1 Stabilization

Stabilization could be accomplished by injecting the stabilization reagents directly into the tanks or pumping the tank contents to the surface and then adding appropriate reagents, mixing the contents, and pumping the contents back into the tanks. Reagents might include grout, sand, cement, clays, pozzolans, and/or polymers. The reagents used, and the suitable proportions, would be selected during treatability testing. The mixture would fill the tank and, therefore, would reduce the risk of collapse. The toxicity of the stabilized waste would not be reduced; however, the unit activity would be reduced, thereby reducing the direct radiation exposure. In addition, the contaminants would be less mobile in the event of a tank breach. The cost of in situ stabilization is relatively low.

In situ stabilization alone will not sufficiently reduce contaminant toxicity, mobility, or volume (TMV). Destruction of organics, such as TCE and BEHP, is necessary to achieve LDR total constituent concentration (not toxicity characteristic leaching procedure [TCLP]) limits of 6 ppm and 28 ppm, respectively. Grout alone would have to reduce the total concentration by orders of magnitude, which is not necessary for stabilization, thereby constituting impermissible dilution. Since stabilization does not remove the organic constituents, it is judged ineffective as a standalone treatment. However, it could be effective in stabilizing leachable constituents, such as RCRA metals. It also could be used as an interim measure to minimize the spread of contamination in the event of a breached tank. Stabilization is retained for further analysis, since it could be useful as a component of other alternatives.

2.4.2 Vitrification

Vitrification is achieved by applying large electrical currents to the waste material with graphite electrodes. The area bounded by the electrodes is heated to over 1,400°C and melted. After cooling, the resulting waste form is a leach-resistant, glass-like material similar to obsidian.

If conducted properly, the effectiveness of this option in meeting RAOs is estimated to be high. This option would mitigate the potential risks to human health and the environment by removing and/or destroying the hazardous organics and certain metals and by significantly reducing potential mobility via leaching.

This technology is effective at encapsulating inorganic contamination, with the exception of mercury and cadmium. These metals, and other volatile compounds detected in the tanks, are likely to volatilize and must be captured and/or treated by the vitrification off-gas system. The semivolatile organic compounds (SVOCs), such as PCBs, typically are destroyed during the vitrification process. Vitrification is retained for further evaluation due its effectiveness in treating V-Tank waste.

2.4.3 Chemical Leaching

Leaching is accomplished by introducing solvents or chelating agents into the tank to selectively dissolve or partition contaminants. Chemicals typically used include nitric acid, oxalic acid, or ethylene diaminetetraacetic acid. Since there appears to be no specific advantage in partitioning the contaminants into another liquid phase, chemical leaching was removed from further consideration.

2.4.4 Oxidation/Reduction

Oxidation/reduction processes also can be considered as an in situ treatment for the tank contents. Oxidizing and/or reducing reagents are mixed with the waste to destroy toxic organics or to change the oxidation state of heavy metals. The efficiency of such processes depends on thorough mixing of reagents with the waste, concentrations, contact time, and temperature. An in situ oxidation/reduction process would require testing to optimize. Oxidation alone will not sufficiently reduce the toxicity and mobility of all contaminants, but it could destroy essentially all hazardous organic constituents. Chemical oxidation/reduction is retained for further analysis, since it could be used in combination with another technology.

2.5 Ex Situ Treatment

The ex situ treatment technologies discussed in the following subsections are discussed generally in the context of treating the tank contents on-Site. However, some of these technologies could be used for treating secondary waste, either on-Site or off-Site.

2.5.1 Neutralization

Neutralization is used to treat corrosive and/or reactive waste. Since the tank waste pH is in the range of 7 to 8, neutralization is not required and is eliminated from further consideration.

2.5.2 Oxidation/Reduction

Oxidizing and/or reducing reagents are mixed with the waste to destroy toxic organics or to change the oxidation state of heavy metals. This technology can be applied ex situ after transferring the waste to a vessel designed for this operation. This technology is retained as a possible treatment process for the reasons described for the in situ application.

2.5.3 Steam Reforming

Historically, steam reforming has been applied to waste containing a significant quantity of organic material. It uses superheated steam to reduce the waste before it is burned in a special reactor without oxygen. This technology is being considered for treatment of contact-handled, organic-contaminated transuranic waste and sodium-bearing waste at the INEEL. However, this concept is only in the alternative evaluation phase for these waste streams. Modifying either of these facilities to process V-Tank waste, although possible, would entail substantial cost and would not be a timely alternative. Availability of portable/temporary treatment units is uncertain. Therefore, steam reforming is not considered a feasible technology for the V-Tank waste at this juncture.

2.5.4 Wet Air Oxidation

Wet air oxidation destroys organic waste using an oxidant in water at high temperatures and pressures. Wet air oxidation is eliminated from further consideration due to the limited amount of PCB destruction information and the expected complexity, risk, and cost of the treatment.

2.5.5 Stabilization

As with the in situ case, stabilization alone will not adequately address the organic contaminants; however, combined with other technologies, it may be effective; therefore, it is retained for further analysis.

2.5.6 Amalgamation

This process is used specifically to stabilize mercury as an insoluble compound, such as mercuric sulfide. There are various methods of capturing the mercury and rendering it nonleachable, such as using SGAC. Generally, the amalgamation technology is effective only for mercury and not other contaminants. Amalgamation is retained for further analysis, since it could be used in combination with another technology.

2.5.7 Encapsulation

This process encases the waste in a matrix of polymer, plastics, grout, or asphalt to immobilize solids that contain hazardous metals. Encapsulation alone is not considered a viable treatment for the V-Tank waste, since the V-Tanks contain organic constituents and mercury; however, it could be used to treat the emptied tanks or process equipment before disposal and is, therefore, retained.

2.5.8 Vitrification

Ex situ vitrification is similar to in situ treatment, except that the waste is removed from the tanks and treated. Portable systems have been designed for on-Site applications. As with in situ vitrification, this technology is retained.

2.5.9 Incineration

Incineration is the treatment standard for waste containing PCBs. The technology is commonly used to destroy the organic constituents in the waste, and it is a viable technology for the V-Tank waste. Incineration will reduce the primary waste volume, since the water will be evaporated and treated in the associated off-gas system. The resulting ash and off-gas waste could require immobilization before final disposal. Though this technology is technically acceptable, no facilities are currently available to accept the mixture of materials in the V-Tanks, including mercury, high-chloride-content organic constituents, radionuclides, and transuranics. Furthermore, unlike vitrification, portable systems generally are not available. Therefore, incineration is not retained as an on-Site treatment method. Certain secondary waste streams (e.g., GAC beds) may be amenable to shipment off-Site and subsequent incineration; therefore, off-Site incineration is retained.

2.5.10 Thermal Oxidation

Similar to incineration, thermal oxidation uses elevated temperatures (above 1,000°C), either through direct or indirect heating, to treat organic constituents. Typically, these units are used in conjunction with other thermal treatment processes (e.g., vitrification) to ensure that any hazardous organics that escape the primary treatment are destroyed before atmospheric discharge. Thermal oxidation is retained for further consideration, in combination with other technologies.

2.5.11 Biological

Biological treatment uses bacteria to destroy organic constituents. The technology is most often used on contaminated soil. Inquiries were made concerning the possibility of using this technology to treat the PCBs. This technology would be experimental, since no demonstration has shown successful treatment of PCBs in a liquid waste medium. This technology is not considered feasible at this stage due to its experimental nature.

2.5.12 Separation

Separation processes exploit the waste's physical or chemical properties to partition constituents in a manner that simplifies disposal. Separation should be considered, in combination with other technologies. The technologies are discussed in further detail below.

2.5.12.1 Reverse Osmosis. These types of systems require prefiltration to enable the high solids content in the V-Tank waste to be processed. Since the sludge phase contains the majority of the CFTs, there does not appear to be any advantage in using this system in conjunction with other processes that would be required. Treatment of the filtered liquid phase by reverse osmosis could be conducted, but the contaminants generally are removed more readily by other systems (e.g., GAC filters). The reverse osmosis technology is not retained for further analysis.

2.5.12.2 Ion Exchange. This technology could be used to remove most of the radionuclides in solution. However, the characterization data indicate that most of the radionuclides are associated with the sludge phase, in which ion exchange would have limited effectiveness. Furthermore, the resulting waste product would still contain metals and organics. These constituents would require subsequent treatment. Reduction of the gamma radiation levels could simplify process design; however, this technology will not be considered further due to the anticipated operational difficulties.

2.5.12.3 Thermal Desorption. Thermal desorption is a process used to separate organics (e.g., TCE and PCBs) and low-boiling-point metals (such as mercury) from an inorganic waste stream. If operated in a batch mode, the process can be operated in a vacuum and at relatively low temperatures (300°C). If the tank waste was to be treated with this process, the volatilized components would have to be treated or collected in the off-gas system. Off-gas treatment could include catalytic oxidation or incineration, either on-Site or off-Site. Off-gas condensates also could require further treatment before disposal. Thermal desorption is retained for further consideration in combination with other technologies.

2.5.12.4 Carbon Adsorption. This process removes relatively low concentrations of contaminants (such as organics) from liquid or gas streams. Since the organic and inorganic concentrations in the tank waste are relatively low, this process is viable for secondary waste that is relatively free of solids. As noted earlier, carbon can be impregnated with chemicals, such as sulfur, to effectively remove additional contaminants such as mercury. The spent carbon might need to be treated before disposal. Carbon adsorption is retained as a treatment option to be used with other technologies.

2.5.12.5 Chemical Precipitation. This process is used to change the solubility of a dissolved contaminant by either changing the contaminant to a less soluble form or changing the solvent chemistry to decrease the contaminant solubility. The precipitate is filtered from the treated waste stream, and it requires additional treatment (such as immobilization) before disposal. Since many CFTs are not dissolved, but are associated with the sludge phase, there are limited apparent advantages to precipitation. Therefore, this process is eliminated from further consideration.

2.5.12.6 Centrifuges. These units are used to separate two-phase waste streams such as the V-Tank waste. A one-time application on a limited amount of waste is not likely to be cost effective relative to filtration, so centrifugation is eliminated from further consideration.

2.5.12.7 Filtration. Commonly, filtration is used to separate solids from liquids or gases. The type of filter used depends on the waste characteristics and particle size of the solids. Because of reduced interim storage, transportation, and treatment costs, filtration was selected previously for treatment of the primary waste when off-Site shipment of only the solid phase was planned. Since only on-Site treatment is currently viable for the sludge phase, the need for complete-phase separation is reduced, making simple-phase separation steps (such as decanting) more attractive. As a minimum, filtration of particulates from off-gas streams will be needed with any technology, so filtration is retained.

2.5.12.8 Distillation or Steam Stripping. Distillation or steam-stripping processes are used to remove volatile organics from aqueous waste streams. Since the volatile organic compound (VOC) and SVOC concentrations in the V-Tanks are very low, and they have widely varying vapor pressures, these processes do not appear to offer any advantage over thermal desorption. Therefore, they are eliminated from further consideration.

2.5.12.9 Evaporation. Evaporation can be used to reduce the aqueous waste volume. The process vaporizes the water from the waste, while the less volatile components remain in a concentrate. Since the V-Tank waste contains low-boiling-point VOCs (e.g., TCE), additional treatment of the vaporized organics would be required. Depending on the organic concentrations, treatment could be as complex as oxidation or as simple as carbon adsorption. Since the VOC concentration in the waste is low, evaporation is a viable treatment process, in combination with other technologies. A possible treatment unit is the Process Equipment Waste Evaporator System located at the Idaho Nuclear Technology and Engineering Center (INTEC). The V-Tank sludge does not meet the waste acceptance criteria for process equipment waste, but the liquid phase and/or off-gas condensate streams are likely to be acceptable, possibly with some pretreatment (carbon adsorption). Evaporation is retained for further consideration.

2.6 Contents Removal

Tank contents' removal can be accomplished by remote or semiremote methods. Vacuum devices have been widely used for decontaminating nuclear facilities. Typically, the suction inlet must be moved over the entire surface of the tank to be emptied. If caked solids are present, additional techniques to loosen or slurry the solids could be required (e.g., air jets, liquid jets, mechanical agitation). If slurrying is accomplished, it might be possible to leave the suction inlet in one location, thereby significantly simplifying the activity. The needed vacuum can be supplied by eductor jets (steam, air, or water), various pump types, or hybrid units (such as fluidic jet systems), which slurry and pump materials. Generally, costs are higher for remotely operated equipment due to complexity, including remote viewing/monitoring. Vacuum-based removal is retained for further consideration. Direct removal of the V-Tank contents is precluded by the radiation level in the waste, and it is eliminated from further evaluation.

2.7 Disposal

The INEEL on-Site, private sector off-Site, and federally owned off-Site facilities are considered for disposal.

2.7.1 Idaho National Engineering and Environmental Laboratory On-Site Disposal

Two INEEL facilities are considered for disposal: the Radioactive Waste Management Complex (RWMC) and the ICDF.

2.7.1.1 *Disposal at the Radioactive Waste Management Complex.* Sections 4.6 and 4.7 of the *Idaho National Engineering and Environmental Laboratory Waste Acceptance Criteria* (DOE-ID 2002b) were reviewed to determine the acceptability of V-Tank CERCLA waste as low-level or mixed low-level waste for disposal.

Section 4.6 of the *Idaho National Engineering and Environmental Laboratory Waste Acceptance Criteria* (DOE-ID 2002b) applies to low-level waste to be stored or disposed of at the INEEL, shipped to an off-Site commercial facility for processing (compaction or sizing), or shipped off-Site for disposal. Since the V-Tank waste is managed as F-listed mixed low-level waste, Section 4.6 of the *Idaho National Engineering and Environmental Laboratory Waste Acceptance Criteria* (DOE-ID 2002b) does not apply, and the V-Tank waste cannot be disposed of at the RWMC. However, if a "no-longer-contained-in" determination or delisting was pursued for any V-Tank waste, then disposal at the RWMC might be a viable option. It is unlikely that these exceptions will be pursued for the V-Tank contents; however, they could possibly be pursued for the soil and some debris.

Section 4.6 of the *Idaho National Engineering and Environmental Laboratory Waste Acceptance Criteria* (DOE-ID 2002b) also prohibits PCBs at concentrations greater than 50 ppm, except for radiologically contaminated PCB bulk-product waste and PCB cleanup waste in accordance with the requirements of 40 *Code of Federal Regulations* (CFR) 761.62 and 40 CFR 761.61(a)(5)(v), respectively. In addition, the RWMC does not accept low-level waste with transuranic (TRU) concentrations greater than 10 nCi/g.

Section 4.7 of the *Idaho National Engineering and Environmental Laboratory Waste Acceptance Criteria* (DOE-ID 2002b) applies to mixed low-level waste shipped to INEEL facilities. This section is only applicable to storage facilities for mixed low-level waste available at the INEEL. The only facility where mixed low-level waste can be disposed of at the INEEL is the ICDF, which is discussed below, and this facility currently is limited to disposal of CERCLA waste. Therefore, no mixed low-level waste can be disposed of at the RWMC. However, V-Tank mixed low-level waste could be temporarily stored at the RWMC, in accordance with the RWMC RCRA permit.

Disposal of low-level waste has been determined to be effective in protecting human health and the environment, and it meets the RAOs. This disposal option is retained for further evaluation to accommodate any low-level waste generated from the V-Tank remedial action or any mixed low-level waste reclassified as low-level waste through appropriate regulatory processes.

2.7.1.2 *Disposal at the INEEL CERCLA Disposal Facility.* The *Waste Acceptance Criteria for ICDF Landfill* report (DOE-ID 2002c) has been reviewed to determine acceptability of V-Tank CERCLA mixed low-level waste for disposal. Based on this review and the planned completion date for this facility, disposal of some or all of the waste from processing the V-Tank contents—including surrounding soil, tanks, and debris—should be acceptable. Solid PCB remediation waste can be disposed of at the ICDF at concentrations up to 500 ppm. Characteristically hazardous waste from outside the INTEC area of contamination must meet the LDR limit of 10 ppm PCB. The ICDF does not accept TRU waste greater than 10 nCi/g.

Most of the technologies being evaluated will result in waste streams that meet the PCB and transuranic limits for the ICDF. However, certain treatment technologies might produce a waste stream that exceeds the 10-nCi/g TRU limit, thereby requiring other disposal facilities.

2.7.2 Commercial Off-Site Disposal

Only three private sector off-Site disposal facilities are available for CERCLA mixed low-level waste. These facilities are Envirocare of Utah, Barnwell Waste Management Facility, and U.S. Ecology at Hanford. These facilities' waste acceptance criteria were reviewed for the V-Tank waste.

2.7.2.1 Envirocare. Envirocare accepts CERCLA mixed low-level waste for disposal. Currently, the Envirocare Radioactive Material License permits disposal of Class A mixed low-level waste only. Envirocare prepared and received approval from the State of Utah Radiation Control Board for a Radioactive Material License allowing the disposal of Class B and C waste. However, Envirocare currently has withdrawn its application. Some of the treatment technologies evaluated for the V-Tank contents might produce a mixed low-level waste with greater-than-Class A radioactivity levels.

Envirocare can accept PCBs as PCB remediation waste at any concentration preapproved by Envirocare. The Envirocare facility is retained as a feasible location for final waste disposal of any V-Tank CERCLA mixed low-level waste streams with less than Class B and C radioactivity levels.

2.7.2.2 Barnwell Waste Management Facility. The *Barnwell Waste Management Facility Site Disposal Criteria, Chem-Nuclear Systems Barnwell Office* (Chem-Nuclear Systems, LLC, 2002) states that "no PCBs or PCB contaminated *[sic]* items will be accepted for disposal" and that treated hazardous waste will be reviewed for acceptance on a case-by-case basis. If a "no-longer-contained-in" determination or delisting was pursued for any V-Tank waste, then disposal at the Barnwell Waste Management Facility could be a viable option. It is unlikely that these exceptions will be pursued for the V-Tank contents; however, they could possibly be pursued for the soil and some debris, although the transportation costs would likely be prohibitive. Nevertheless, the Barnwell Waste Management Facility is retained as a feasible location for final waste product disposal, since there are PCB treatment processes under consideration that could produce an acceptable waste product.

2.7.2.3 U.S. Ecology Commercial Low-level Radioactive Disposal Facility at Hanford. The commercial low-level radioactive disposal site operated by U.S. Ecology, Inc., only receives low-level waste from off-Site facilities belonging to the Northwest LLW Compac. Class A, B, and C waste is received at this facility; no RCRA waste can be received at this facility. Transuranic waste with concentrations greater than 10 nCi/g must have State of Washington approval before receipt. Some PCB waste is acceptable, with restrictions on container size and volume due to the placement restrictions in the disposal facility. If a "no-longer-contained-in" determination or delisting was pursued for any V-Tank waste, then disposal at the Hanford U.S. Ecology low-level radioactive disposal site could be a viable option. It is unlikely that these exceptions will be pursued for the V-Tank contents, but they could possibly be pursued for the soil and some debris.

2.7.3 Federally Owned Off-Site Disposal

2.7.3.1 Waste Isolation Pilot Plant. Waste destined for the WIPP must be defense-related waste, which would qualify the V-Tank waste since it is defense-related waste. The *Contact-Handled Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP 2002) states that the lower limit for contact- or remote-handled transuranic waste is 100 nCi/g of transuranic radionuclides. If a waste volume-reduction process (such as evaporation or thermal desorption) is used, production of a concentrate that has a specific activity of more than 100 nCi/g transuranic is feasible. Depending on the treatment process, the WIPP is a possible repository for the final waste form.

2.7.3.2 Hanford Environmental Restoration Disposal Facility. The Environmental Restoration Disposal Facility (ERDF) is the CERCLA disposal facility at Hanford. Review of the *Environmental Restoration Disposal Facility Waste Acceptance Criteria* (Corriveau and Obenauer 1995) indicated the following limitations for accepting the V-Tank waste:

- Solidified organic liquids containing 500 ppm or greater PCBs will not be accepted for disposal
- Currently, ERDF does not accept any waste from outside the Hanford reservation
- Transuranic concentration must be <100 nCi/g.

The ERDF is retained as a feasible location for final waste disposal, since there are PCB treatment processes under consideration that could produce an acceptable waste product, and it is possible that the off-Site restriction could be negotiated.

2.7.3.3 Hanford Mixed Low-Level Burial Grounds Trenches 31 and 34. The *Hanford Site Solid Waste Acceptance Criteria* (Hanford 2002) states that Trenches 31 and 34 of the 218-W-5 Burial Ground are lined RCRA-compliant units for disposal of certain low-level mixed waste. Currently, only low-level waste originally designated with RCRA characteristic numbers D001 through D043 and certain listed waste numbers (F001 through F005, and F039 derived from F001 through F005 waste) are accepted in Trenches 31 and 34. All waste accepted at Trenches 31 and 34 must meet the applicable LDR treatment standards of 40 CFR 268, "Land Disposal Restrictions," and Waste Acceptance Criteria 173-303-140. Prohibited waste includes TSCA-regulated PCB waste—except as specifically authorized by 40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," and waste generated from CERCLA cleanup activities—unless specific approval (e.g., a ROD) has been granted by the EPA to manage the waste on the Hanford Site. The waste's TRU content cannot exceed 100 nCi/g. Currently, Trenches 31 and 34 are managed by Fluor Hanford, which does not accept off-Site mixed low-level waste. However, this site will be retained as a possible disposal facility, since receipt of the V-Tank waste could be negotiated.

2.7.3.4 Nevada Test Site. The *Nevada Test Site Waste Acceptance Criteria* (NTS 2002) states that only dewatered bulk PCB remediation waste with <50 ppm of PCBs is accepted for disposal. The waste's TRU concentration must not exceed 100 nCi/g. Currently, the NTS does not accept off-Site mixed low-level waste. However, negotiations currently are in progress to allow receipt of off-Site mixed low-level waste meeting LDRs. The NTS is retained as a feasible location for the final waste disposal.

2.8 Summary of Retained Technologies

The following list summarizes those primary and secondary treatment technologies that were retained through the screening process and incorporated into Section 3, "Development of Alternatives." Primary technologies represent the primary treatment process that would be applied to the tank contents. Secondary technologies are those that would be used in conjunction with the primary technology to treat secondary waste streams. (Note: In situ technologies are identified specifically. All others are assumed to be ex situ technologies.)

Primary technologies include:

- In situ vitrification
- Vitrification

- In situ chemical oxidation/reduction followed by stabilization
- Chemical oxidation/reduction with stabilization
- Thermal desorption.

Secondary technologies include:

- Amalgamation
- Encapsulation
- Incineration (off-Site only)
- Thermal oxidation
- Carbon absorption
- Filtration (off-gas)
- Evaporation.

Only remote tank-contents removal was retained, and the waste form disposal alternatives were all retained through the screening process, but they are not repeated or summarized here.

3. DEVELOPMENT OF ALTERNATIVES

From the list of potentially viable technologies identified in the previous section, and through continued evaluation of these as outlined in the Technology Evaluation Scope of Work (DOE-ID 2002a), three primary technologies ultimately were retained: (1) vitrification, (2) thermal desorption, and (3) chemical oxidation/reduction with stabilization. Specific alternatives associated with each technology, for which formal, detailed evaluations were conducted, are summarized below:

Vitrification:

- Alternative 1.a—In Situ Vitrification: In situ vitrification with disposal of the primary and the majority of the secondary waste streams at the ICDF

- Alternative 1.b—Ex Situ Vitrification: On-Site ex situ vitrification with disposal of the primary and the majority of the secondary waste streams at the ICDF.

Thermal Desorption:

- Alternative 2.a—Thermal Desorption On-Site/Off-Site: On-Site thermal desorption with disposal of residue at the ICDF and off-Site treatment and disposal of the secondary waste streams

- Alternative 2.b—Thermal Desorption On-Site: On-Site thermal desorption with disposal of residue at the ICDF and on-Site treatment and disposal of the secondary waste streams

- Alternative 2.c—Thermal Desorption Off-Site: On-Site thermal desorption with disposal of stabilized residue off-Site and off-Site treatment and disposal of the secondary waste streams.

Chemical Oxidation/Reduction with Stabilization:

- Alternative 3.a—In Situ Chemical Oxidation/Reduction followed by Stabilization: In situ chemical oxidation/reduction followed by stabilization with disposal of the primary and the majority of the secondary waste streams at the ICDF

- Alternative 3.b—Ex Situ Chemical Oxidation/Reduction followed by Stabilization: On-Site ex situ chemical oxidation/reduction followed by stabilization with disposal of the primary and the majority of the secondary waste streams at the ICDF.

The simplified PFDs presented in the following discussions are not intended to depict the detail of actual designs, and only those streams (shown in bold print in the figures) considered by the evaluation criteria are represented in the simplified mass balance tables. Significant effort was expended to identify and estimate the magnitude and approximate characterization of the expected waste streams to ensure that the ARARs were considered comprehensively and disposition pathways were identified for all waste. The summary waste disposition tables present an overview of the waste to be generated, the expected treatment requirements, and the planned disposition pathway. A greater level of detail is captured in the *Pre-Conceptual Designs of Various Alternatives for the V-Tanks, TSF-09/18 at Waste Area Group 1 Operable Unit 1-10* (INEEL 2002a), where the individual process streams are defined. Only limited information was obtained from potential technology vendors during this preconceptual design phase, so most of the design content was developed by technology experts at the INEEL. For each alternative identified previously, it was assumed that a portion of the liquid (approximately 6,000 gal) from Tank V-3 was decanted, treated, stabilized, and disposed of at the ICDF before treatment of the remaining sludge and liquid in the tanks. Consequently, the material to be treated by each alternative consisted of a combination of liquid and sludge, as follows:

- Tank V-1—520 gal of sludge, plus 1,164 gal of liquid
- Tank V-2—458 gal of sludge, plus 1,138 gal of liquid
- Tank V-3—652 gal of sludge, plus 1,660 gal of liquid
- Tank V-9—250 gal of sludge, plus 70 gal of liquid.

As noted in Section 1.1, removal of 6,000 gal of liquid supernatant from Tank V-3 might not be completed. However, removal was assumed to ensure a common basis for performing the evaluation. In addition, it should be noted that the final design for the preferred alternative might differ from the preconceptual designs used in this evaluation.

3.1 Alternative 1.a—In Situ Vitrification with Disposal of the Primary and the Majority of the Secondary Waste Streams at the INEEL CERCLA Disposal Facility

Vitrification is a thermal treatment process used to convert various types of waste materials into chemically inert, stable glass and crystalline waste forms. The process involves Joule heating (heat produced by passing current through a resistive load—in this case, the targeted waste materials) to temperatures of 1,400–2,000°C, which is sufficient to melt the solid portion of the waste. Upon cooling, the vitrified waste form hardens into a durable glass and crystalline product with a leach resistance similar to that of basalt or obsidian.

During vitrification, nonvolatile inorganic contaminants and radionuclides in the waste are chemically incorporated into the glass and crystalline matrix, while hazardous organic contaminants are either destroyed in place (via pyrolysis) or removed and captured in the accompanying off-gas system (depending on their volatility). During the vitrification process, semivolatile inorganic contaminants (e.g., mercury and chlorides) also are removed from the waste and captured in the off-gas system.

Application to the V-Tanks involves deployment of an in situ vitrification system, complete with the associated off-gas cleanup system. A simplified PFD of in situ vitrification is shown in Figure 5, a summary mass balance showing the concentration of key streams is shown in Table 4, and waste types and volumes are summarized in Table 5.

In this process, graphite electrodes are installed in the soil around the tank to melt the waste in place. Then, sufficient current is passed (initially through a conductive starter path between electrodes), then through the melting soil, and, ultimately, through a molten mass incorporating soil, the tank, and the waste contents to form a relatively homogeneous vitrified mass. The type of melt conducted is referred to as a planar melt, in which the melt takes place at the level of the V-Tanks (10 to 20 ft below grade), eventually incorporating the tank and waste, but allowing vapors to emerge to the surface. Before beginning the melting process, soil (and possibly other absorbent fill material) is added to the tanks. Existing tank lines and portals are enlarged, as necessary, to direct and capture most of the off-gases above the ground, thereby precluding subsurface pressure buildup. A large hood is placed over the area to capture the off-gases, which are treated through various wet (or dry) scrubber systems, filters, and a thermal oxidizer (TO) before being discharged. Granular-activated carbon and sulfur-impregnated granular activated carbon filters are used to remove organics and mercury, respectively, from the off-gases. The off-gas is assumed to be treated to meet MACT requirements. Secondary waste scrubber solutions are generated and must be treated and disposed of at the ICDF.

For all identified technologies, current plans call for clean closure of the tank system. For in situ vitrification, the resulting vitrified mass will be sized, removed, and disposed of at the ICDF. Surrounding soil will be sampled and disposed of at the ICDF, as required. Clean soil will be used to backfill the area of contamination. The selected vendor will establish the exact number of melts, but could range from one melt, if all of the sludge is first consolidated into one tank, to four melts, if each tank is treated separately. For this preconceptual design, it was assumed that one melt of the consolidated waste in one tank will be conducted. Although other waste material (e.g., piping) potentially could be incorporated into the melt. This was not factored into the design, but was considered during the evaluation process.

Another possible pretreatment option for the proposed in situ vitrification process involves decanting additional liquid (more than the aforementioned 6,000 gal) from the V-Tanks before initiating vitrification. By removing as much liquid as possible from the melt before in situ vitrification processing, the overall in situ vitrification process is made more efficient by eliminating the need to evaporate/boil off the water before melting the tank contents. In addition, removing excess free liquid from the tanks makes the overall in situ vitrification process more implementable. Therefore, in the preconceptual design, an additional decanting step to remove excess free liquid has been included before transferring the tank contents into one tank. The decanted liquid is processed with activated carbon to remove organic contaminants, and the liquid is stabilized for disposal at the ICDF. However, this option is not a prerequisite for planar in situ vitrification processing.

For purposes of estimating the mass balance around the in situ vitrification process, characterization data from other in situ vitrification applications were extrapolated as a basis for assuming that water and VOCs are vented from the waste during the initial heating produced by melting the soil around the tanks. These vapors are caught in the off-gas system liquid condensate or adsorbed onto activated carbon. Semivolatile organic compounds are pyrolized and destroyed in the melting process. Cadmium, chlorides, and mercury are vaporized from the melt and captured in the condensate, the HEPA filters, or in sulfur-impregnated carbon. In addition, trace amounts of radionuclides are partitioned between the melt, the condensate, and the HEPA filters. Only the carbon beds are disposed of off-Site; all other materials are disposed of at the ICDF.

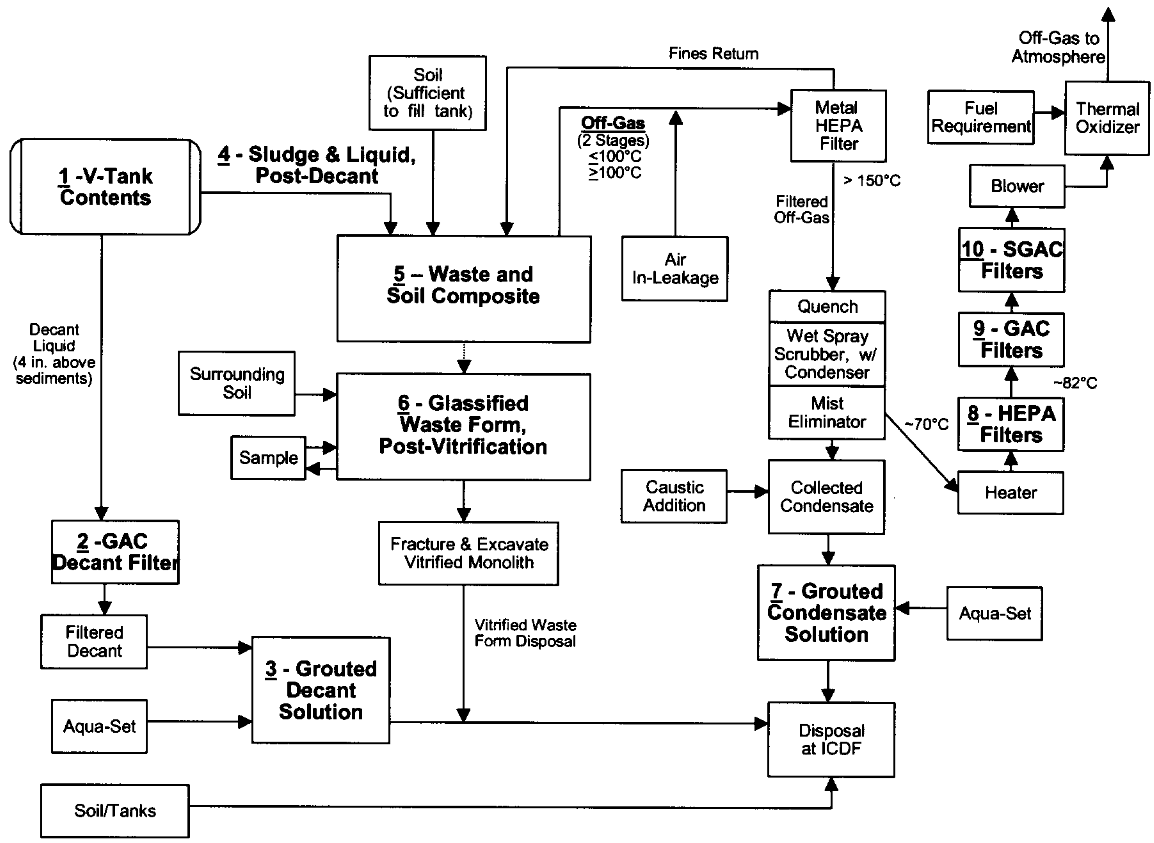

Figure 5. Alternative 1.a. process flow diagram for in situ vitrification.

Table 4. Summary mass balance for in situ vitrification.

Stream Name	V-Tank Contents	GAC Decant Filter	Grouted Decant Solution	Sludge and Liquid, Post-Decant	Decanted Sludge and Added Soil, Pre-Vitrification	Glassified Waste Form, Post-Vitrification	Grouted Condensate Solution	HEPA Filters	GAC Filter	SGAC Filter
Stream Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Volume (L)	2.24E+04	2.06E+01	1.47E+04	1.03E+04	3.79E+04	1.64E+05	3.41E+04	4.53E+02	1.99E+03	1.99E+03
Mass (kg)	2.26E+04	8.25E+00	1.69E+04	1.06E+04	6.32E+04	4.50E+05	3.91E+04	1.51E+01	7.94E+02	7.94E+02
Component										
Inorganics										
Cd (mg/kg)	2.02E+01	0	3.09E-02	4.32E+01	7.22E+00	0	7.28E-04	1.14E+00	0	0
Chlorides (mg/kg)	1.36E+02	0	9.42E+01	1.42E+02	2.37E+01	0	4.80E+01	0	0	0
Cr (mg/kg)	5.96E+02	0	9.82E-02	1.28E+03	2.72E+02	1.05E+02	0	0	0	0
Hg (mg/kg)	2.59E+02	Trace	7.99E-02	5.55E+02	9.27E+01	0	Trace	Trace	Trace	7.37E+03
Pb (mg/kg)	2.82E+02	0	1.82E-01	6.03E+02	1.01E+02	1.41E+01	Trace	Trace	0	0
VOCs										
PCE (mg/kg)	2.37E+02	4.27E+02	0	5.07E+02	8.47E+01	0	0	0	6.74E+03	Trace
TCA (mg/kg)	1.05E+02	1.22E+03	0	2.23E+02	3.72E+01	0	0	0	2.96E+03	Trace
TCE (mg/kg)	8.54E+02	8.97E+03	0	1.82E+03	3.05E+02	0	0	0	2.42E+04	Trace
SVOCs										
BEHP (mg/kg)	9.10E+02	1.53E+02	0	1.95E+03	3.26E+02	0	0	0	Trace	Trace
Araclor-1260 (mg/kg)	3.59E+01	1.45E+02	0	7.68E+01	1.28E+01	0	0	0	Trace	Trace
Radionuclides										
Cs-137 (nCi/g)	1.98E+03	0	4.13E+00	4.23E+03	7.06E+02	9.91E+01	3.42E-05	Trace	0	0
Sr-90 (nCi/g)	3.68E+03	0	7.74E+00	7.87E+03	1.32E+03	1.85E+02	2.13E-05	Trace	0	0
Transuranic (nCi/g)	8.57E+00	0	3.03E-03	1.84E+01	3.07E+00	4.30E-01	4.96E-08	Trace	0	0
Other										
Total Carbon (mg/kg)	2.53E+04	8.90E+04	0	5.42E+04	2.24E+04	0	0	0		Trace

BEHP = bis(2-ethylhexyl)phthalate
GAC = granular-activated carbon
HEPA = high-efficiency particulate air
PCE = tetrachloroethylene
SGAC = sulfur-impregnated granular-activated carbon
SVOC = semivolatile organic compound
TCA = trichloroethane
TCE = trichloroethylene
VOC = volatile organic compound

Table 5. Summary of waste types, volumes, expected treatments, and expected disposition for in situ vitrification.

Generated Waste Type	Volume	Expected Treatment	Expected Disposition
PRIMARY WASTE	**2,250 m^3 TOTAL**		
Grouted decant solution (Item 3 in PFD)	12 m^3 unstabilized, 14.8 m^3 stabilized	None—complete	ICDF (71 55-gal drums)
Glassified waste form (Item 6 in PFD)	165 m^3 (includes 0.95 m^3 of metal, 0.31 m^3 of phosphate, and 164 m^3 of vitrified waste form)	Fractured vitrified waste form in place, then excavate. Phosphate material will be packaged in two 55-gal drums.	ICDF, without packaging, for vitrified waste form and metal debris ICDF (two 55-gal drums) for phosphate material
Contaminated soil/tank area of contamination	2,070 m^3 (includes 2,068 m^3 of soil, 0.61 m^3 of tank shells, and 1.6 m^3 of piping)	Excavated (no treatment)	ICDF (without packaging)
SECONDARY WASTE	**123 m^3 TOTAL**		
GAC decant filter (Item 2 in PFD)	0.33 m^3	Thermal	Permafix/Envirocare
Grouted condensate solution (Item 7 in PFD)	27.9 m^3 unstabilized, 34.2 m^3 stabilized	None—complete	ICDF (157 55-gallon drums, plus the filled Tank V-9 shell)
Spent HEPA filters (Item 8 in PFDs)	0.45 m^3	Macroencapsulation for disposal	ICDF (four HEPA filters)
GAC filters (Item 9 in PFD)	2.0 m^3	Thermal	Permafix/Envirocare
SGAC filter (Item 10 in PFD)	2.0 m^3	None—complete	ICDF
Used PPE, consumable materials, nonrecoverable equipment	83.9 m^3	Macroencapsulation for disposal (as needed)	ICDF (Assume 12 10-yd^3 waste boxes)

GAC = granular-activated carbon
HEPA = high-efficiency particulate air
ICDF = INEEL CERCLA Disposal Facility
PFD = process flow diagram
PPE = personal protective equipment
SGAC = sulfur-impregnated granular-activated carbon

3.2 Alternative 1.b—On-Site Ex Situ Vitrification with Disposal of the Primary and the Majority of the Secondary Waste Streams at the INEEL CERCLA Disposal Facility

In the ex situ vitrification alternative, the tank contents are transferred into a nearby aboveground vitrification unit. The vitrification unit is preinsulated to preclude melting the container during ex situ vitrification processing. Then, soil from the area is added concurrently with the tank contents to provide the proper mix. A simplified PFD of ex situ vitrification is shown in Figure 6, a summary mass balance showing the concentration of key streams is shown in Table 6, and waste types and volumes are summarized in Table 7.

Graphite electrodes are used, as described in the in situ vitrification description, to vitrify the waste. However, in this application, all of the melting occurs inside the prefabricated vitrification unit, and the V-Tanks are not incorporated. The process includes an off-gas cleanup system comparable to the one required for in situ vitrification, and it produces comparable waste streams for disposal. The solidified mass and the prefabricated container(s) would be directly disposed of at the ICDF. As with the in situ vitrification alternative, additional decanting of the V-Tank supernatant is proposed as a pretreatment step to enhance melter efficiency and improve ex situ vitrification process implementability. However, the decanting process should not be considered a prerequisite.

To the extent possible, other waste (such as piping and soil) is incorporated into each melt. Then, the tanks and other contaminated soil are removed and disposed of at the ICDF. Finally, the area of contamination is backfilled and clean-closed.

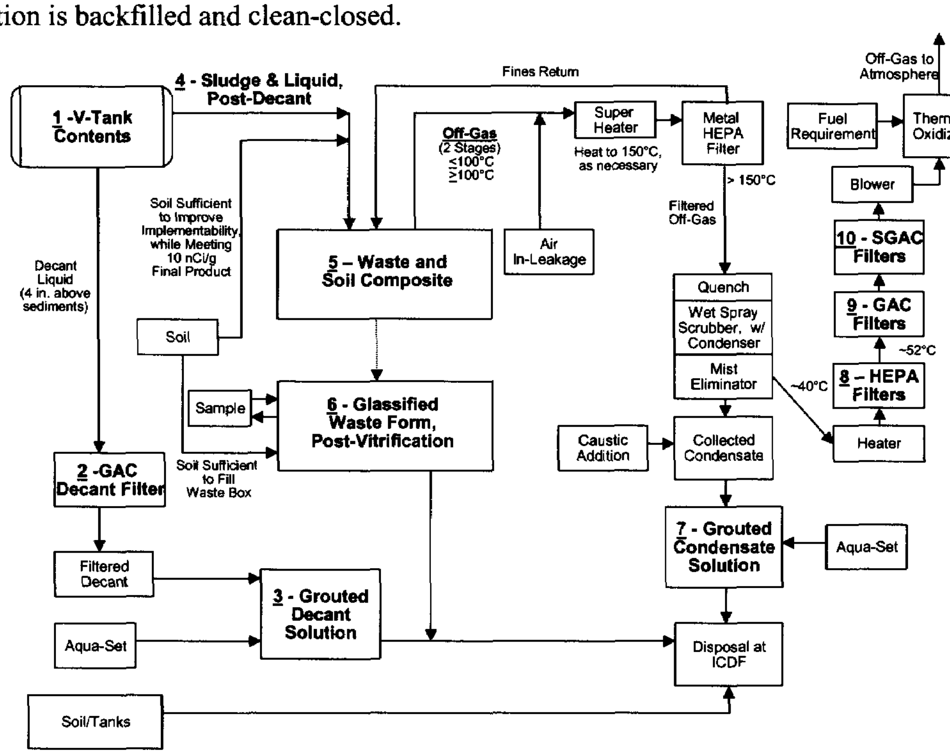

Figure 6. Alternative 1.b process flow diagram for ex situ vitrification.

Table 6. Summary mass balance for ex situ vitrification.

Stream Name	V-Tank Contents	GAC Decant Filter	Grouted Decant Solution	Sludge and Liquid Post-Decant	Decanted Sludge and Added Soil, Pre-Vitrification	Glassified Waste Form, Post-Vitrification	Grouted Condensate Solution	HEPA Filters	GAC Filter	SGAC Filter
Stream Number	1	2	3	4	5	6	7	8	9	10
Volume (L)	2.24E+04	2.06E+01	1.47E+04	1.03E+04	3.23E+04	1.17E+04	6.99E+03	4.53E+02	1.82E+03	1.82E+03
Mass (kg)	2.26E+04	8.25E+00	1.69E+04	1.06E+04	5.04E+04	3.15E+04	8.01E+03	1.51E+01	7.27E+02	7.27E+02
Component										
Inorganics										
Cd (mg/kg)	1.36E+02	0	3.09E-02	4.32E+01	9.06E+00	0	5.68E-03	1.12E-02	0	0
Chlorides (mg/kg)	1.65E+02	0	9.42E+01	1.42E+02	2.97E+01	0	2.57E+02	0	0	0
Cr (mg/kg)	5.96E+02	0	9.82E-02	1.28E+03	3.23E+02	5.18E+02	0	0	0	0
Hg (mg/kg)	2.59E+02	Trace	7.99E-02	5.55E+02	1.16E+02	0	Trace	Trace	Trace	8.05E+03
Pb (mg/kg)	2.82E+02	0	1.82E-01	6.03E+02	1.26E+02	2.02E+02	Trace	Trace	0	0
VOCs										
PCE (mg/kg)	2.37E+02	4.27E+02	0	5.07E+02	1.06E+02	0	0	0	7.36E+03	Trace
TCA (mg/kg)	1.05E+02	1.22E+03	0	2.23E+02	4.67E+01	0	0	0	3.23E+03	Trace
TCE (mg/kg)	8.54E+02	8.97E+03	0	1.82E+03	3.82E+02	0	0	0	2.65E+04	Trace
SVOCs										
BEHP (mg/kg)	9.10E+02	1.53E+02	0	1.95E+03	4.08E+02	0	0	0	Trace	Trace
Araclor-1260 (mg/kg)	3.59E+01	1.45E+02	0	7.68E+01	1.61E+01	0	0	0	Trace	Trace
Radionuclides										
Cs-137 (nCi/g)	1.98E+03	0	4.13E+00	4.23E+03	8.86E+02	1.42E+03	1.67E-04	Trace	0	0
Sr-90 (nCi/g)	3.68E+03	0	7.74E+00	7.87E+03	1.65E+03	2.64E+03	1.04E-04	Trace	0	0
Transuranic (nCi/g)	8.57E+00	0	3.03E-03	1.84E+01	3.85E+00	6.16E+00	2.42E-07	Trace	0	0
Other										
Total Carbon (mg/kg)	2.53E+04	8.90E+04	0	5.42E+04	2.41E+04	0	0	0		Trace

BEHP = bis(2-ethylhexyl)phthalate
GAC = granular-activated carbon
HEPA = high-efficiency particulate air
PCE = tetrachloroethylene
SGAC = sulfur-impregnated granular-activated carbon
SVOC = semivolatile organic compound
TCA = trichloroethane
TCE = trichloroethylene
VOC = volatile organic compound

Table 7. Summary table of generated waste, volumes, and expected disposition for ex situ vitrification.

Generated Waste Type	Volume	Expected Treatment	Expected Disposition
PRIMARY WASTE	**2,427 m^3 TOTAL**		
Grouted decant solution (Item 3 in PFD)	12 m^3 unstabilized, 14.8 m^3 stabilized	None—complete	ICDF (71 55-gal drums)
Roll-off boxes, containing glassified waste form (Item 6 in PFD)	Total volume of 68.9 m^3, (includes 36 m^3 of refractory material, 11.7 m^3 of vitrified waste form, and 21.2 m^3 of contaminated soil)	No further treatment is required. Soil is added to fill the void left from subsidence, during the batch ex situ vitrification process.	ICDF (Six roll-off boxes)
Contaminated soil/tank area of contamination	2,343 m^3 (includes 2,340 m^3 of soil, 1.5 m^3 of tank shell, and 1.6 m^3 of miscellaneous piping)	Excavated (no treatment)	ICDF (without packaging)
SECONDARY WASTE	**88 m^3 TOTAL**		
GAC decant filters (Item 2 in PFD)	0.33 m^3	Thermal	Permafix/Envirocare
Grouted condensate solution (Item 7 in PFD)	5.7 m^3 unstabilized, 7.1 m^3 stabilized	None—complete	ICDF (27 55-gal drums, plus the filled Tank V-9 shell)
Spent HEPA filters (Item 8 in PFD)	0.45 m^3	Macroencapsulation for disposal	ICDF (four HEPA filters)
GAC filters (Item 9 in PFD)	1.8 m^3	Thermal	Permafix/Envirocare
SGAC filters (Item 10 in PFD)	1.8 m^3	None—complete	ICDF
Used PPE, consumable materials, nonrecoverable equipment	76.4 m^3	Macroencapsulation for disposal (as needed)	ICDF (Assume 12 10-yd^3 waste boxes)

GAC = granular-activated carbon
HEPA = high-efficiency particulate air
ICDF = INEEL CERCLA Disposal Facility
PFD = process flow diagram
PPE = personal protective equipment
SGAC = sulfur-impregnated granular-activated carbon

3.3 Alternative 2.a—On-Site Thermal Desorption with Disposal of Residue at the INEEL CERCLA Disposal Facility and Off-Site Treatment and Disposal of the Secondary Waste Streams

Typically, thermal desorption is used as a separation process, often as the first step in a treatment train. Thermal desorption removes water, volatile organics, and volatile metals (such as mercury) from solids and liquids by raising the temperature of the waste to a level sufficient to volatilize contaminants and transfer them to the off-gas stream. After the various hazardous constituents are separated into discrete waste streams, these relatively homogenous waste types can be treated separately.

Various thermal desorption technologies employ differing combinations of temperature, residence times, feed mixing, and vacuum to heat the material and transfer the contaminants to the off-gas stream. Most commercial applications have been performed on contaminated soil. Several classes of thermal desorber units have emerged, including indirect- and direct-heated units, units operated at atmospheric conditions, and units operated under vacuum. The thermal desorption system proposed for treatment of V-Tanks liquid and sludge waste will be a vacuum thermal desorption unit (an indirectly heated rotary kiln, operated under vacuum). However, the vacuum need not be applied until after the higher-volume, lower-temperature VOCs (and water) have been desorbed.

Using this alternative, V-Tank contents are transferred to the thermal desorption unit and combined with soil from the area of contamination. Unlike the vitrification process, additional liquid (in excess of the 6,000 gal from Tank V-3) is not decanted first. A simplified PFD of thermal desorption on-Site/off-Site, which combines on-Site disposal of thermal desorption waste with off-Site treatment and disposal of off-gas residuals, is shown in Figure 7. A summary mass balance showing the concentration of key streams is shown in Table 8, and waste types and volumes are summarized in Table 9.

Initially, liquid and sludge waste is removed from each V-Tank using a fluidic jet-removal system and pumped directly to the thermal desorption unit, where it is combined with soil sufficient to adjust moisture levels to within the normal operating range of the thermal desorption unit. Once the soil/waste has been received, the thermal desorption unit is set in rotation and heated for 1 hour at 95°C at 620 mm Hg (low-temperature mode of operation). During this period, 100% of the water and low-temperature organic contaminants and about 20% of the mercury is desorbed. Following low-temperature operations, a vacuum (40 mm Hg) is established on the rotating vessel, and the unit is heated for 2 hours at up to 400°C (high-temperature mode of operation). It is during this period that 100% of the SVOCs and the remaining mercury is desorbed.

Not unlike the vitrification process, a relatively sophisticated off-gas system is used to collect and treat the off-gas. Since the process operates at lower temperatures, cesium levels in the off-gas system are reduced. No on-Site organic destruction technology is used in this alternative, so the off-gas treatment train is not designed to be compliant with MACT requirements. In addition, during high-temperature operations, the condenser and mist eliminator are bypassed to maintain the off-gas temperature (after nitrogen dilution) and avoid condensation before the GAC/SGAC filters. Partitioning of contaminants is similar to the vitrification process in that VOCs are captured on activated carbon and mercury is adsorbed on sulfur-impregnated carbon. However, cadmium is not volatilized due to the lower operating temperature. The SVOCs are captured on the activated carbon. These slightly radioactive off-gas waste streams (condensate and filters) will be containerized and shipped off-Site for treatment and disposal. Details on the contaminant partitioning can be found in Table 8.

After high-temperature operation, the waste containing most of the heavy metals and radionuclides is cooled and transferred to the hopper vessel for containerization. Based on the material balances, this material should not require stabilization and can be containerized and disposed of at the ICDF. The tanks and remaining soil also would be disposed of at the ICDF.

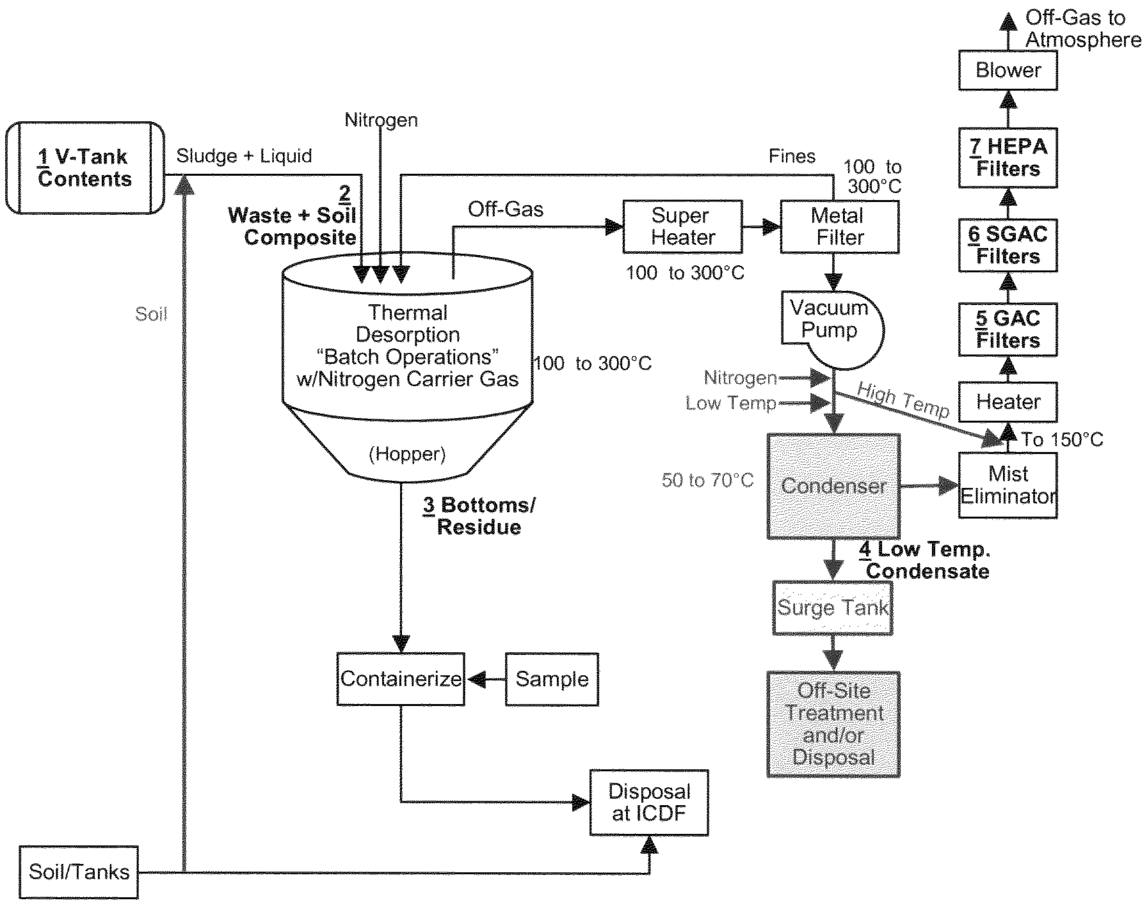

Figure 7. Alternative 2.a process flow diagram for thermal desorption on-Site/off-Site.

Table 8. Summary mass balance for thermal desorption on-Site/off-Site.

Stream Name	V-Tank Contents	Waste + Soil Composite	Bottoms Residue	Low-Temperature Condensate	GAC Filters	SGAC Filters	HEPA Filters
Stream Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Volume (L)	2.24E+04	1.82E+05		5.03E+04	1.84E+4	9.91E+01	
Mass (kg)	2.26E+04	3.04E+05	2.43E+05	5.03E+04	7.36E+3	3.96E+01	
Component							
Inorganics							
Cd (mg/kg)	2.02E+01	1.49E+00	1.86E+00				
Chlorides (ppm)	1.36E+02	1.67E+01	2.06E-03		1.65E+2		
Cr (mg/kg)	5.96E+02	4.44E+01	5.54E+01				
Hg (mg/kg)	2.59E+02	1.93E+01	2.35E-02	1.50E+01		1.29E+4	
Pb (mg/kg)	2.82E+02	2.00E+01	2.62E+01				
VOC							
PCE (ppm)	2.37E+02	2.91E+01	0.00E+00	2.14E+01	2.30E+2		
TCA (ppm)	1.05E+02	1.29E+01	0.00E+00	9.42E+00	1.02E+2		
TCE (ppm)	8.54E+02	1.05E+02	0.00E+00	7.71E+01	8.28E+2		
SVOC							
BEHP (ppm)	9.10E+02	1.12E+02	8.81E-02		1.11E+3		
PCBs (ppm)	3.59E+01	4.42E+00	3.44E-03		4.36E+1		
Radionuclide							
Cs-137 (nCi/g)	1.98E+03	1.47E+02	1.84E+02	Trace	Trace		Trace
Sr-90 (nCi/g)	3.68E+03	2.74E+02	3.41E+02	Trace	Trace		Trace
Transuranic (nCi/g)	8.57E+00	6.37E-01	7.97E-01	Trace	Trace		Trace
Other							
Total Organic Carbon (ppm)	2.53E+04	3.11E+03	0.00E+00		3.08E+4		

BEHP = bis(2-ethylhexyl)phthalate
GAC = granular-activated carbon
HEPA = high-efficiency particulate air
PCE = tetrachloroethylene
SGAC = sulfur-impregnated granular-activated carbon
SVOC = semivolatile organic compound
TCA = trichloroethane
TCE = trichloroethylene
VOC = volatile organic compound

Table 9. Summary of generated waste, volumes, and expected disposition for thermal desorption on-Site/off-Site.

Generated Waste Type	Volume	Expected Treatment	Expected Disposition
PRIMARY WASTE	**2,407 m^3**		
Bottoms/residue (Item 3 in PFD)	203 m^3	None—Calculations indicate that stabilization is not required.	ICDF
Contaminated soil/tanks from V-Tank area of contamination	2,204 m^3	Excavated (no treatment)	ICDF
SECONDARY WASTE	**133 m^3**		
Low-temperature condensate (Item 4 in PFD)	48.3 m^3	Thermal and stabilization for disposal	Permafix/Envirocare
GAC filters (Item 5 in PFD)	24.9 m^3	Thermal	Permafix/Envirocare
SGAC filters (Item 6 in PFD)	1.1 m^3	None—complete	Envirocare
HEPA filters (Item 7 in PFD)	0.7 m^3	Macroencapsulation for disposal	Envirocare
Used PPE, consumable materials, nonrecoverable equipment	58.1 m^3	Macroencapsulation for disposal (as needed)	ICDF (or Envirocare)

GAC = granular-activated carbon
HEPA = high-efficiency particulate air
ICDF = INEEL CERCLA Disposal Facility
PFD = process flow diagram
PPE = personal protective equipment
SGAC = sulfur-impregnated granular-activated carbon

3.4 Alternative 2.b—On-Site Thermal Desorption with Disposal of Residue at the INEEL CERCLA Disposal Facility and On-Site Treatment and Disposal of the Secondary Waste Streams

This alternative employs a thermal desorption system identical to the previous alternative, but the off-gas system is modified to include organic destruction, which facilitates treatment of all secondary waste on-Site. This process uses a TO for destroying the organics, versus off-Site treatment and disposal; thus, the off-gas system is designed to MACT requirements. A simplified PFD of thermal desorption on-Site is shown in Figure 8, a summary mass balance showing the concentration of key streams is shown in Table 10, and waste types and volumes are summarized in Table 11.

Rather than collecting the organic constituents on carbon beds, they are destroyed by the thermal oxidizer as they are desorbed. This allows the wet scrub/quench system to be operated during both low- and high-temperature desorption. This causes more condensation of volatilized constituents and reduces the requirement for activated carbon. A somewhat different partitioning of volatile species is produced, resulting in more chlorides and mercury entering the scrub system. Then, the scrub/condensate solutions are stabilized. All waste products from this alternative can be disposed of at the ICDF.

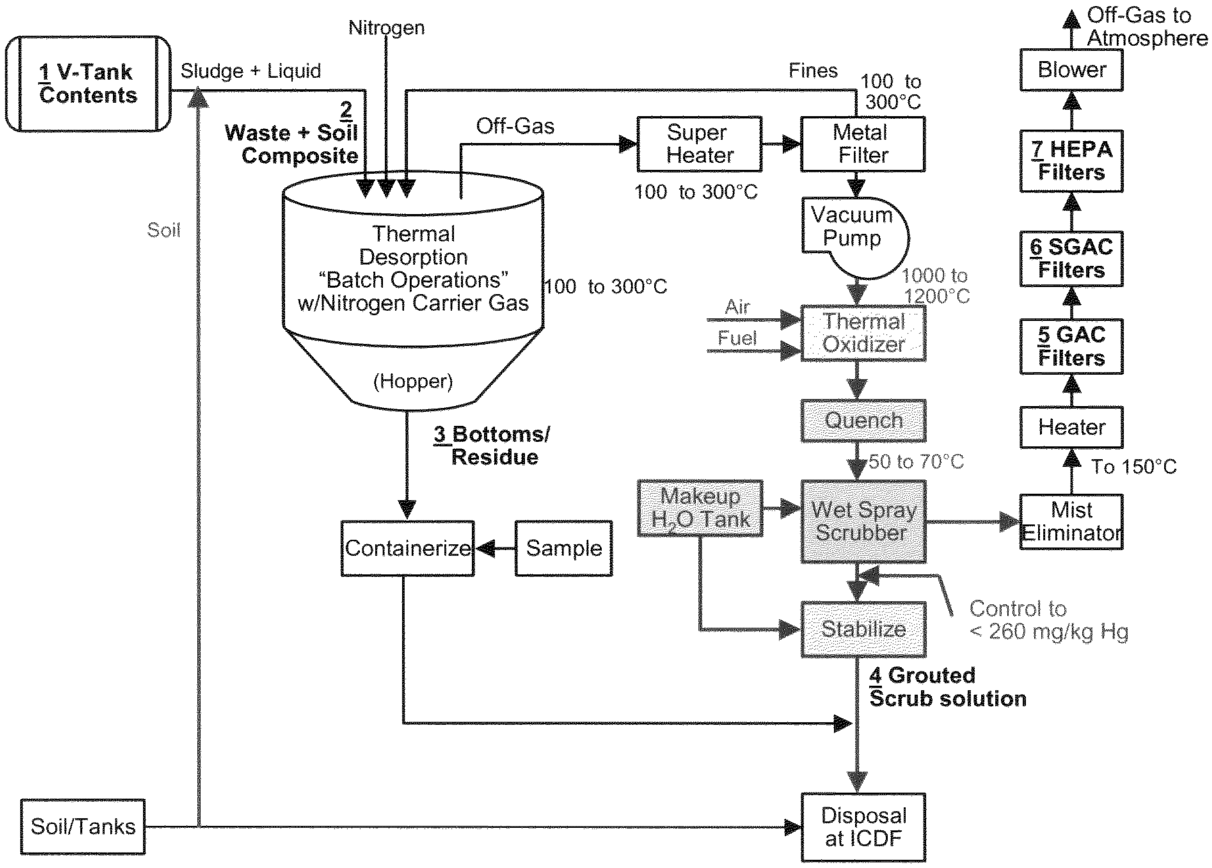

Figure 8. Alternative 2.b process flow diagram for thermal desorption on-Site.

Table 10. Summary mass balance for thermal desorption on-Site.

Stream Name	V-Tank Contents	Waste + Soil Composite	Bottoms/ Residue	Grouted Scrub Solutions	GAC Filters	SGAC Filters	HEPA Filters
Stream Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Volume (L)	2.24E+04	1.82E+05	2.43E+05	1.41E+4	2.49E+4	5.89E+3	
Mass (kg)	2.26E+04	3.04E+05	2.43E+05	1.41E+4	9.97E+3	2.36E+3	
Component							
Inorganics							
Cd (mg/kg)	2.02E+01	1.49E+00	1.86E+00				
Chlorides (ppmv)	1.36E+02	1.67E+01	2.06E-03	2.16E+2			
Cr (mg/kg)	5.96E+02	4.44E+01	5.54E+01				
Hg (mg/kg)	2.59E+02	1.93E+01	2.35E-02	1.50E+2	1.11E+2	1.11E+3	
Pb (mg/kg)	2.82E+02	2.00E+01	2.62E+01				
VOC							
PCE (ppmv)	2.37E+02	2.91E+01	0.00E+00				
TCA (ppmv)	1.05E+02	1.29E+01	0.00E+00				
TCE (ppmv)	8.54E+02	1.05E+02	0.00E+00				
SVOC							
BEHP (ppmv)	9.10E+02	1.12E+02	8.81E-02				
PCBs (ppmv)	3.59E+01	4.42E+00	3.44E-03				
SVOCs (ppmv)	2.78E+01	3.42E+00	0.00E+00				
Radionuclide							
Cs-137 (nCi/g)	1.98E+03	1.49E+02	1.84E+02		Trace	Trace	Trace
Sr-90 (nCi/g)	3.68E+03	2.74E+02	3.41E+02		Trace	Trace	Trace
Transuranic (nCi/g)	8.57E+00	6.37E-01	7.97E-01		Trace	Trace	Trace
Other							
Total Organic Carbon (ppmv)	2.53E+04	3.11E+03	0.00E+00				

BEHP = bis(2-ethylhexyl)phthalate
GAC = granular-activated carbon
HEPA = high-efficiency particulate air
PCE = tetrachloroethylene
SGAC = sulfur-impregnated granular-activated carbon
SVOC = semivolatile organic compound
TCA = trichloroethane
TCE = trichloroethylene
VOC = volatile organic compound

Table 11. Summary table of generated waste, volumes, and expected disposition for thermal desorption on-Site.

Generated Waste Type	Volume	Expected Treatment	Expected Disposition
PRIMARY WASTE	**2,407 m^3**		
Bottoms/residue (Item 3 in PFD)	203 m^3	None—Calculations indicate that stabilization is not required.	ICDF
Contaminated soil/tanks from V-Tank area of contamination	2,204 m^3	Excavated (no treatment)	ICDF
SECONDARY WASTE	**110 m^3**		
Grouted scrub solution (Item 4 in PFD)	16.5 m^3	None—complete	ICDF
GAC filters (Item 5 in PFD)	5.7 m^3	None—complete	ICDF
SGAC filters (Item 6 in PFD)	5.7 m^3	None—complete	ICDF
HEPA filters (Item 7 in PFD)	0.7 m^3	Macroencapsulation for disposal	ICDF
Used PPE, consumable materials, nonrecoverable equipment	81.7 m^3	Macroencapsulation for disposal (as needed)	ICDF

GAC = granular-activated carbon
HEPA = high-efficiency particulate air
ICDF = INEEL CERCLA Disposal Facility
PFD = process flow diagram
PPE = personal protective equipment
SGAC = sulfur-impregnated granular-activated carbon

3.5 Alternative 2.c—On-Site Thermal Desorption with Disposal of Stabilized Residue Off-Site and Off-Site Treatment and Disposal of the Secondary Waste Streams

This alternative eliminates the use of soil in the desorber, allowing a smaller unit to be used, and it results in waste products suitable for off-Site treatment and disposal (NTS, Hanford, etc.). A simplified PFD of thermal desorption off-Site is shown in Figure 9, a summary mass balance showing the concentration of key streams is shown in Table 12, and waste types and volumes are summarized in Table 13.

As in the previous thermal desorption alternatives, liquid and sludge waste is removed from each V-Tank using a fluidic jet-removal system and pumped directly to the thermal desorption unit (4 ft in diameter and 8.5 ft long), but no carrier soil is employed. This minimizes the residual waste volume, but also maximizes the radiological concentration. The staged desorption process is identical to that described in the first thermal desorption alternative (2.a) in that it uses an off-gas system without on-Site organic destruction and does not require design to MACT requirements. Partitioning of the desorbed constituents amongst the secondary waste streams is, therefore, similar to the first thermal desorption alternative, although the volume is reduced due to elimination of the soil addition. Details of this distribution can be found in Table 12.

After high-temperature operation, the inorganic waste containing most of the heavy metals and radionuclides is cooled and transferred to the hopper vessel for containerization. After containerization, the waste is placed in interim storage and later shipped to an off-Site disposal facility, such as the WIPP, NTS, or Hanford. In the event transuranic levels meet WIPP criteria, the residue will be stored without stabilization. If the transuranic levels are less than the WIPP criteria (>100 nCi/g, which is expected based on the material balance), the residue will be stabilized to meet LDRs and comply with NTS and Hanford waste acceptance criteria and radiological licenses. Currently, these sites are accepting only mixed waste from within their respective states and are pursuing the capability to receive out-of-state waste. Since they are not currently authorized to accept V-Tank waste, it is assumed that the waste (inorganic bottoms/residue) will be placed in on-Site interim storage for approximately 2 years until authorization is granted.

The secondary off-gas waste streams are treated and disposed of at other facilities off-Site (as in the thermal desorption on-Site/off-Site alternative). The tanks and soil will be sent to the ICDF for disposal.

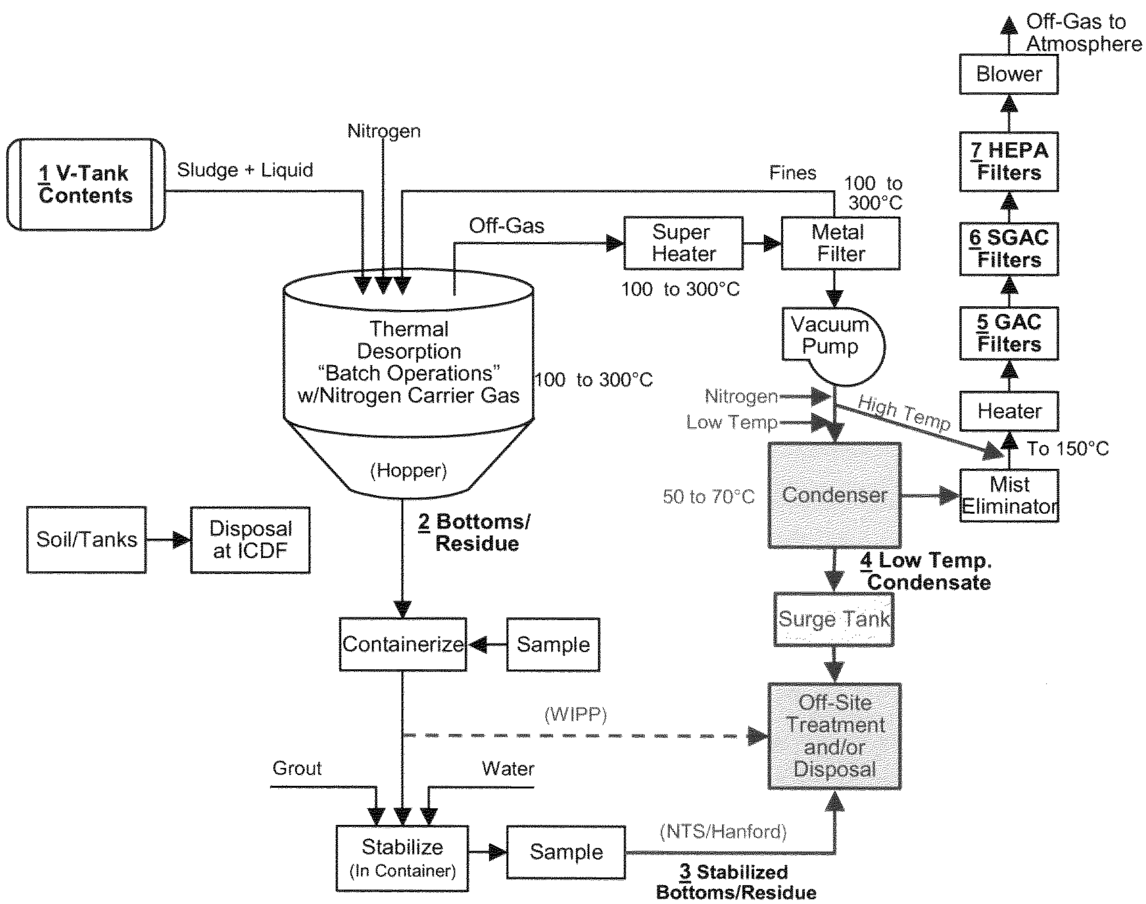

Figure 9. Alternative 2.c process flow diagram for thermal desorption off-Site.

Table 12. Summary mass balance for thermal desorption off-Site.

Stream Name	V-Tank Contents	Bottoms/ Residue	Stabilized Bottoms/ Residue	Low-Temperature Condensate	GAC Filters	SGAC Filters	HEPA Filters
Stream Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Volume (L)	2.24E+04	2.80E+03	5.0E+03	1.37E+04	1.84E+4	6.51E+02	
Mass (kg)	2.26E+04	2.80E+03	7.0E+03	1.37E+04	7.36E+3	2.60E+02	
Component							
Inorganics							
Cd (mg/kg)	2.02E+01	1.61E+02	6.46E+01				
Chlorides (ppmv)	1.36E+02	1.84E-01	1.05E-01		1.65E+2		
Cr (mg/kg)	5.96E+02	4.81E+03	1.92E+3				
Hg (mg/kg)	2.59E+02	1.68E+00	1.11E+00	5.14E+01		1.97E+4	
Pb (mg/kg)	2.82E+02	2.28E+03	9.10E+02				
VOC							
PCE (ppmv)	2.37E+02	0.00E+00	0.00E+00	7.94E+01	2.29E+2		
TCA (ppmv)	1.05E+02	0.00E+00	0.00E+00	3.47E+01	1.02E+2		
TCE (ppmv)	8.54E+02	0.00E+00	0.00E+00	2.84E+02	8.28E+2		
SVOC							
BEHP (ppmv)	9.10E+02	7.63E+00	4.4E+00		1.11E+3		
PCBs (ppmv)	3.59E+01	3.07E-01	1.75E-01		6.36E+1		
Radionuclide							
Cs-137 (nCi/g)	1.98E+03	1.60E+6	6.39E+3	Trace	Trace	Trace	Trace
Sr-90 (nCi/g)	3.68E+03	2.98E+04	1.19E+04	Trace	Trace	Trace	Trace
Transuranic (nCi/g)	8.57E+00	6.92E+01	2.77E+01	Trace	Trace	Trace	Trace
Other							
Total Organic Carbon (ppmv)	2.53E+04	0.00E+00	0.00E+00		3.08E+4		

BEHP = bis(2-ethylhexyl)phthalate
GAC = granular-activated carbon
HEPA = high-efficiency particulate air
PCE = tetrachloroethylene
SGAC = sulfur-impregnated granular-activated carbon
SVOC = semivolatile organic compound
TCA = trichloroethane
TCE = trichloroethylene
VOC = volatile organic compound

Table 13. Summary table of generated waste, volumes, and expected disposition for thermal desorption off-Site.

Generated Waste Type	Volume	Expected Treatment	Expected Disposition
PRIMARY WASTE	**2,397 m^3**		
Stabilized bottoms/residue (Item 3 in PFD)	2.4 m^3 unstabilized, 5 m^3 stabilized	None—complete	NTS, Hanford
Contaminated soil/tanks from V-Tank area of contamination	2,392 m^3	Excavated (no treatment)	ICDF
SECONDARY WASTE	**93 m^3**		
Low-temperature condensate (Item 4 in PFD)	13.1 m^3	Thermal and stabilization for disposal	Permafix/Envirocare
GAC filters (Item 5 in PFD)	24.9 m^3	Thermal	Permafix/Envirocare
SGAC filters (Item 6 in PFD)	1.1 m^3	None—complete	Envirocare
HEPA filters (Item 7 in PFD)	0.7 m^3	Macroencapsulation for disposal	Envirocare
Used PPE, consumable materials, nonrecoverable equipment	53.4 m^3	Macroencapsulation for disposal (as needed)	ICDF (or Envirocare)

GAC = granular-activated carbon
HEPA = high-efficiency particulate air
ICDF = INEEL CERCLA Disposal Facility
NTS = Nevada Test Site
PFD = process flow diagram
PPE = personal protective equipment

3.6 Alternative 3.a—In Situ Chemical Oxidation/Reduction and Stabilization with Disposal of the Primary and the Majority of the Secondary Waste Streams at the INEEL CERCLA Disposal Facility

The chemical oxidation and stabilization process proposed for treatment of V-Tank waste is a low-temperature process using an aqueous solution of sodium persulfate to convert organic solids and liquids to carbon dioxide, water, and halide salts at temperatures below 100°C. In situ CO/S is proposed as a batch process occurring in sequence in Tanks V-1, V-2, and V-3. The contents of Tank V-9 will be transferred to Tank V-2 before processing using a fluidic jet system, which also will facilitate mixing of the chemical oxidant throughout the process. A simplified PFD of IS-CO/S is shown in Figure 10, a summary mass balance showing the concentration of key streams is shown in Table 14, and waste types and volumes are summarized in Table 15.

To complete the preconceptual designs that provided the basis for the comparative analysis, it was necessary to assume a specific oxidant—in this case, sodium persulfate. However, other oxidants or reductants may be specified ultimately during the design phase.

The tank contents will be maintained at a controlled pH with sodium hydroxide and nitric acid. Acidic conditions are generally favored for oxidation, while basic solutions are favored for stabilization of halide-rich mixtures. Then, persulfate, in aqueous solution (29 w% solution), will be added in three successive aliquots. The first aliquot will be added while the solution is at ambient temperature (approximately 20°C) and will consist of a volume of persulfate solution equal to 20% of the initial volume of waste in each tank. Adding the first aliquot of persulfate before heating to 80°C will allow initiation of chemical oxidation/reduction on the VOCs. This will minimize the mass of VOCs that must be captured in the GAC bed. Adjusting the pH might be necessary during chemical oxidation to keep the oxidizing solution from becoming too acidic. Then, the solution will be held at 80°C, and the second and third aliquots of persulfate will be added to complete the reaction.

Upon completion of the final reaction step, the oxidized liquid waste will be sampled and analyzed for key contaminants (BEHP, etc.). If sufficient destruction and removal efficiencies (DREs) have not been achieved, then the mixture will be further reacted until compliance is achieved. Once adequate destruction efficiency is achieved, the pH will be checked and adjusted, as necessary, to facilitate stabilization to (1) stabilize the remaining inorganic contaminants, metals, and radionuclides, and (2) eliminate free liquid so the resulting solid can be sent to the ICDF for disposal. Adjusting the pH after chemical oxidation is necessary since groutability of the processed waste is optimized at, or near, the pH of the grout used in the solidification. The pH of most cementitious grouts is approximately pH 10–12. In-tank grouting will be accomplished using a multiport injection system (or equivalent). Sampling and analysis of grouted waste will be completed to verify compliance with regulatory standards (e.g., LDRs) before disposal. The tanks and surrounding soil would then be removed and disposed of at the ICDF.

The off-gas system is used to capture any water or contaminants (VOCs, mercury, etc.) evaporated during the exothermic oxidation step. The condensate is continuously recycled back to the tank to increase destruction of any VOCs. Any VOCs not condensed are captured on a GAC filter that will be treated and disposed of at an off-Site TSDF, since VOC concentrations are expected to exceed the ICDF's waste acceptance criteria. If there are residual mercury vapors, they are captured on a SGAC filter that can be disposed of at the ICDF, since it is expected to meet the ICDF's waste acceptance criteria.

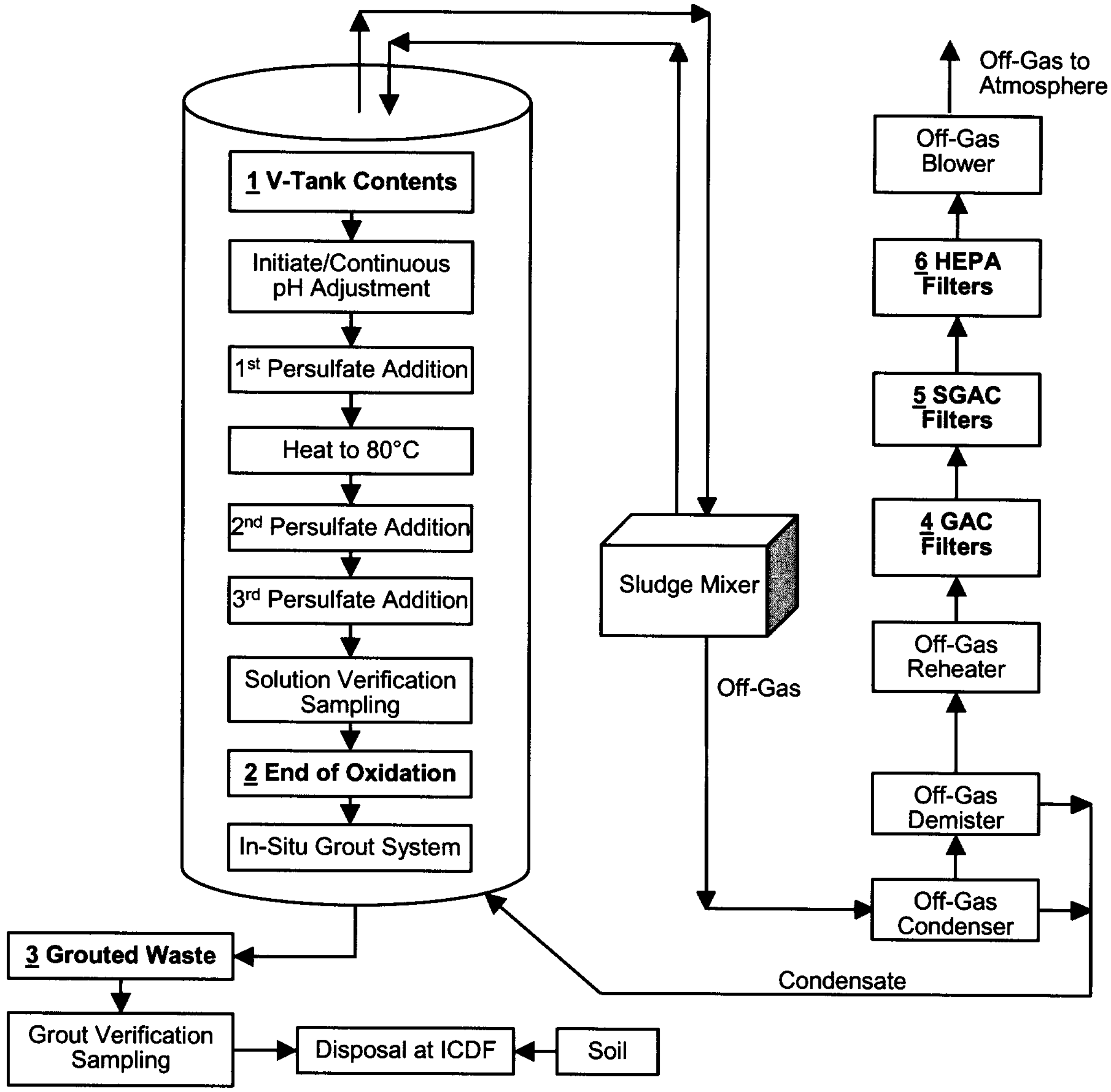

Figure 10. Alternative 3.a process flow diagram for in situ chemical oxidation/reduction followed by stabilization.

Table 14. Summary mass balance for in situ chemical oxidation/reduction followed by stabilization and ex situ chemical oxidation/reduction followed by stabilization.

Stream Name	V-Tank Contents	End of Oxidation	Grouted Waste	GAC Filter	SGAC Filter	HEPA Filter
Stream Number	**1**	**2**	**3**	**4**	**5**	**6**
Volume (L)	2.24E+04	3.15E+04	6.70E+04	4.16E+02	4.16E+02	3.00E+02
Mass (kg)	2.26E+04	3.29E+04	1.15E+05	1.67E+02	1.67E+02	1.0E+01
Component						
Inorganics						
Cd (mg/kg)	2.02E+01	1.39E+01	3.96E+00	0.00E+00	0.00E+00	0.00E+00
Chlorides (mg/kg)	1.36E+02	7.99E+02	2.28E+02	0.00E+00	0.00E+00	0.00E+00
Cr (mg/kg)	5.96E+02	4.09E+02	1.17E+02	0.00E+00	0.00E+00	0.00E+00
Pb (mg/kg)	2.82E+02	1.93E+02	5.53E+01	0.00E+00	0.00E+00	0.00E+00
Hg (mg/kg)	2.59E+02	1.78E+02	5.08E+01	0.00E+00	3.50E+01	0.00E+00
VOCs						
PCE (mg/kg)	2.37E+02	1.46E+00	4.18E-01	6.41E+01	0.00E+00	0.00E+00
TCA (mg/kg)	1.05E+02	7.20E-01	2.06E-01	2.84E+01	0.00E+00	0.00E+00
TCE (mg/kg)	8.54E+02	2.93E+00	8.37E-01	2.31E+02	0.00E+00	0.00E+00
SVOC						
BEHP (mg/kg)	9.10E+02	6.24E+01	1.78E+01	6.16E+01	0.00E+00	0.00E+00
PCBs (mg/kg)	3.59E+01	3.69E+00	1.06E+00	2.43E+00	0.00E+00	0.00E+00
Radionuclide						
Cs-137 (nCi/g)	1.98E+03	1.36E+03	3.88E+02	0.00E+00	0.00E+00	0.00E+00
Sr-90 (nCi/g)	3.68E+03	2.52E+03	7.21E+02	0.00E+00	0.00E+00	0.00E+00
Transuranic (nCi/g)	8.57E+00	5.88E+00	1.68E+00	0.00E+00	0.00E+00	0.00E+00
Other						
Total Organic Carbon (ppm)	2.53E+04	1.74E+02	4.96E+01	–	0.00E+00	0.00E+00

* Chlorides are reflective of dissolved free chloride ion in solution.
BEHP = bis(2-ethylhexyl)phthalate
GAC = granular-activated carbon
HEPA = high-efficiency particulate air
PCE = tetrachloroethylene
SGAC = sulfur-impregnated granular-activated carbon
SVOC = semivolatile organic compound
TCA = trichloroethane
TCE = trichloroethylene
VOC = volatile organic compound

Table 15. Summary table of generated waste, volumes, and expected disposition for in situ chemical oxidation/reduction followed by stabilization.

Generated Waste Type	Volume	Expected Treatment	Expected Disposition
PRIMARY WASTE	**2,462 m^3**		
Grouted waste (in tank) (Item 3 in PFD)	75 m^3	None—complete	ICDF
Contaminated soil/tanks from V-Tank area of contamination	2,387 m^3	Excavated (no treatment)	ICDF
SECONDARY WASTE	**44 m^3**		
GAC filters (Item 4 in PFD)	1 m^3	Thermal	Permafix/Envirocare
SGAC filters (Item 5 in PFD)	1 m^3	None—complete	ICDF
HEPA filters (Item 6 in PFD)	0.3 m^3	Macroencapsulation for disposal	ICDF
Used PPE, consumable materials, nonrecoverable equipment	42 m^3	Macroencapsulation for disposal (as needed)	ICDF

GAC = granular-activated carbon
HEPA = high-efficiency particulate air
ICDF = INEEL CERCLA Disposal Facility
PFD = process flow diagram
PPE = personal protective equipment
SGAC = sulfur-impregnated granular-activated carbon

3.7 Alternative 3.b—On-Site Ex Situ Chemical Oxidation/Reduction and Stabilization with Disposal of the Primary and the Majority of the Secondary Waste Streams at the INEEL CERCLA Disposal Facility

This final alternative applies a chemical oxidation/reduction process identical to IS-CO/S, maintaining the relative benefits of contamination control in a low-temperature liquid process, while conducting the treatment ex situ in a reaction vessel designed for this application. The vessel minimizes concerns with efficient heating, mixing, and corrosion control, because it can be designed specifically to facilitate the ES-CO/S operation. Corrosion is a specific concern because of the aggressive chemistry used at slightly elevated temperatures, particularly in the presence of chlorides. As with IS-CO/S, a specific oxidant (persulfate) was identified, but other oxidants or reductants may be selected during the design phase. A simplified PFD for ES-CO/S is shown in Figure 11. The summary mass balance is the same as that shown for IS-CO/S in Table 14, and the summary waste disposition is shown in Table 16.

For this alternative, the waste from the V-Tanks is consolidated initially into three tanks by pumping the contents from Tank V-9 into Tank V-2. Then, ex situ chemical oxidation is performed in batches of "to be determined" volume, pumped sequentially out of each of the three tanks. The supernatant and sediment phases within each tank initially are mixed together using a fluidic jet mixer to produce more uniform batches within the V-Tanks prior to transfer to the reaction vessel, where the chemical oxidation reaction is to take place. The proposed mixing process involves transferring a portion of the tank waste into a small charge vessel and then discharging it back into the tank at high pressure (<60 psi) to stir up the tank contents. This process is repeated until the tank supernatant and sludge phases are mixed sufficiently. Then, the mixed tank waste is transferred to the reaction vessel using the same system that was used to mix the tank contents.

Once in the reaction vessel, the waste will be stirred vigorously. Before and during chemical oxidation, the stirred tank waste will be adjusted and maintained at a controlled pH, as necessary, to enhance the chemical oxidation reaction. The chemical oxidant will be introduced to the stirred tank in stages to allow for oxidation of tank contents in a batch-processing manner. The initial stage will focus on the VOCs; so, there is a desire to minimize the reaction vessel's temperature during this time. Later stages will focus on oxidation of the SVOCs (such as PCBs and oil components), which could require heating to ensure sufficient destruction.

During chemical oxidation, there might be significant volatilization of hazardous VOCs into the off-gas system, despite operation at lower temperature. To attempt a more complete oxidation, the volatized organics will be condensed, with the condensate recycled back to the reaction vessel. The GAC, SGAC, and HEPA filters between the condenser and the off-gas blower will be used to fully capture noncondensable hazardous off-gases and respirable particulate before their release to the environment.

Once a batch chemical oxidation is complete, the reaction vessel's contents will be transferred and mixed with cementitious grout for stabilization purposes. Stabilization will be done in the same container used for disposal. Upon removing the chemically oxidized waste from the reaction vessel, it will be recharged with another batch of well-mixed tank sludge. This continues until the entire contents of the three tanks have been oxidized and stabilized. The containerized, stabilized waste will be sampled to verify compliance with the waste acceptance criteria and will be disposed of at the ICDF. The empty tanks and surrounding soil would then be removed and disposed of at the ICDF.

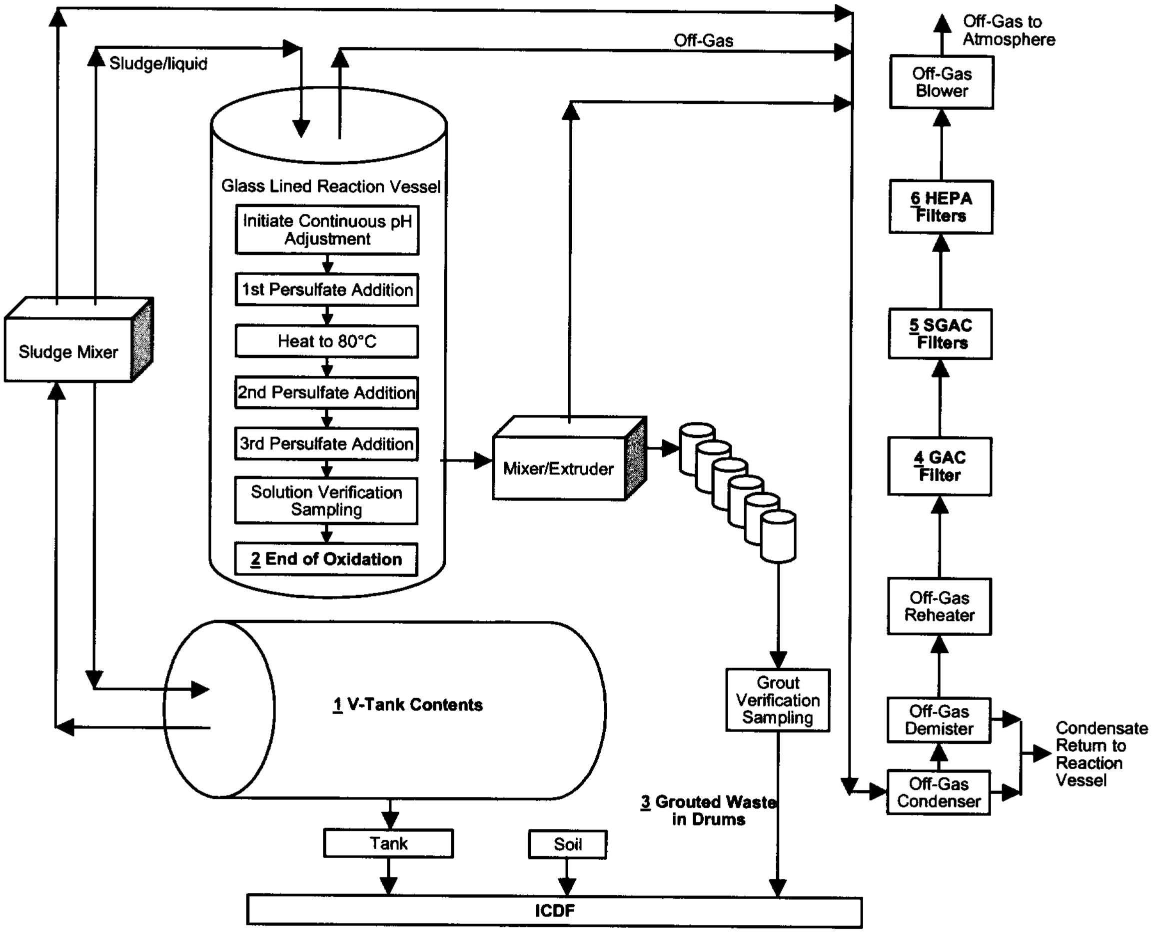

Figure 11. Alternative 3.b process flow diagram for ex situ chemical oxidation/reduction followed by stabilization.

Table 16. Summary table of generated waste, volumes, and expected disposition for ex situ chemical oxidation/reduction followed by stabilization.

Generated Waste Type	Volume	Expected Treatment	Expected Disposition
PRIMARY WASTE	**2,469 m^3**		
Grouted waste (in drums) (Item 3 in PFD)	78 m^3	None—complete	ICDF
Contaminated soil/tanks from V-Tank area of contamination	2,391 m^3	Excavated (no treatment)	ICDF
SECONDARY WASTE	**60 m^3**		
GAC filters (Item 4 in PFD)	1 m^3	Thermal	Permafix/Envirocare
SGAC filters (Item 5 in PFD)	1 m^3	None—complete	ICDF
HEPA filters (Item 6 in PFD)	0.3 m^3	Macroencapsulate for disposal	ICDF
Used PPE, consumable materials, nonrecoverable equipment	58 m^3	Macroencapsulate for disposal (as needed)	ICDF

GAC = granular-activated carbon
HEPA = high-efficiency particulate air
ICDF = INEEL CERCLA Disposal Facility
PFD = process flow diagram
PPE = personal protective equipment
SGAC = sulfur-impregnated granular-activated carbon

4. DETAILED ANALYSIS OF ALTERNATIVES

4.1 Comprehensive Environmental Response, Compensation, and Liability Act Threshold, Balancing, and Modifying Criteria

The technology evaluation process allowed a thorough evaluation of the alternatives as they relate to the CERCLA criteria. To ensure that all necessary data were collected to allow an informed decision that would minimize future implementation issues, a matrix of data needs was developed and used to guide the technology evaluation process (DOE-ID 2002a).

To decide on a new remedial alternative for the V-Tanks, the three Agencies agreed to use a CERCLA-based decision support model, which was developed for a similar treatment decision at Waste Area Group 7 on the INEEL, as an aid in selecting a preferred alternative. The criteria were evaluated by inputting preconceptual design data into the model and incorporating the value functions and weighting factors developed by the Agencies. A value function is a correlation between the range of values for a particular criterion and the range of merit values assigned to that criterion.

The results of the alternative evaluation were presented to the Agencies at a meeting held October 23 and 24, 2002. After thorough discussion, a consensus selection of a preferred alternative was made (see Section 5) for presentation in the proposed plan.

The primary CERCLA criteria are listed below, followed by a short discussion specific to the V-Tank alternative evaluations:

- Protection of Human Health and the Environment—A preliminary review of the various technologies was conducted to ensure that environmental, safety, and health concerns are addressed. This review identified the major system risks and potential controls necessary to mitigate those risks. Although this is a threshold criterion, the ability to implement these controls and their short-term effectiveness also was assessed, as described below.

- Compliance with ARARs—A preliminary review of the ARARs was completed. The selected remedy ultimately will identify all technology-specific ARARs as well as any required exceptions, waivers, or variances. A preliminary listing of ARARs for the preferred alternative is provided in Section 5.2. To establish whether each alternative meets this threshold criterion, the composition of each generated waste stream was determined and compared against disposal requirements for various facilities. All of the technology alternatives are believed to meet the applicable TSDFs' waste acceptance criteria, as described in detail in Section 3.

- Long-Term Effectiveness and Permanence—Since clean closure of the V-Tanks site is achieved following remediation, this criterion only addresses the remaining soil and associated contaminant of concern—Cs-137. Each alternative will remove the tank contents, tanks, and surrounding soil and dispose of these elsewhere, either on-Site or off-Site. Therefore, the CFTs are not a factor for this criterion. The final remediation goal for the site is equivalent for all alternatives (23.3 pCi/g Cs-137). The disposal sites for the V-Tank waste streams have conducted performance assessments previously and, from these, have established appropriate waste acceptance criteria. The next criterion specifically addresses the treatment process's effectiveness on the ability of the task contents' waste form to meet these acceptance criteria.

- Reduction of Toxicity, Mobility, and Volume through Treatment—A PFD, mass balances, and disposition pathway for each waste stream (primary and secondary) were developed for each of the seven alternatives. Such data ensure a complete assessment of this criterion. Factors used to evaluate this criterion include volume of primary and secondary waste generated and the composition of the waste forms, specifically the CFTs. The transuranic, cadmium, lead, mercury, TCE, PCB, and BEHP contaminants were selected as representative and bounding constituents associated with the specific treatment processes. The treatment process's ability to effectively achieve reduction of toxicity and mobility of these CFTs was evaluated.

- Short-Term Effectiveness—In part, this criterion was addressed by the safety review mentioned previously under Protection of Human Health and the Environment. Furthermore, it established whether the technologies could meet the overall schedule established by the V-Tank Project. Any of the technologies would be deployed under the INEEL requirements to ensure worker and public safety and, therefore, might score similarly in this area. However, the complexity and cost to ensure operation within the INEEL requirements might vary significantly. This complexity was evaluated as part of the safety aspects of short-term effectiveness.

- Cost—The Bechtel BWXT Idaho, LLC, Cost-Estimating organization prepared a life-cycle cost estimate. Past data from estimates related to the V-Tanks and similar projects were used as input to the extent possible. This includes costs for preparing the associated documentation, such as the proposed plan, ROD amendment, and remedial design/remedial action work plan. Previous estimates for soil and tank removal were used, as well as liquid removal and treatment costs. Cost for design, deployment, and operation of the treatment process was obtained through experienced cost estimators. These cost estimates were prepared, minus escalation costs, and then were discounted to net present value, using standard discount factors (see Appendix A).[b] These costs were done at a preconceptual level and are expected to be within the CERCLA guidelines of +50/-30%.

- State/Support Agency Acceptance—The State of Idaho and EPA provided early consensus on the technologies to be evaluated (DOE-ID 2002a). They also participated in a comparative analysis work session on October 23 and 24, which lead to consensus on a preferred alternative for the proposed plan. Agency approval of the regulatory measures in a future ROD amendment, which is required to support implementation of each evaluated technology, also was addressed in the October 2002 Agency meeting. Additional state/support agency acceptance will be obtained following the public comment period on the proposed plan.

- Community Acceptance—The majority of public input will be obtained during review of the proposed plan. However, to advise the public of the V-Tank Project redirection, a fact sheet (INEEL 2002b) was issued identifying the technologies selected for evaluation and allowing public feedback. This provided the project and Agencies with an early indication of potential issues and questions likely to be raised during the formal public comment period.

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b. INEEL, 2002a, "INEEL Preliminary Cost Estimates 6302–6308 (Draft)," Idaho National Engineering and Environmental Laboratory, November 2002.

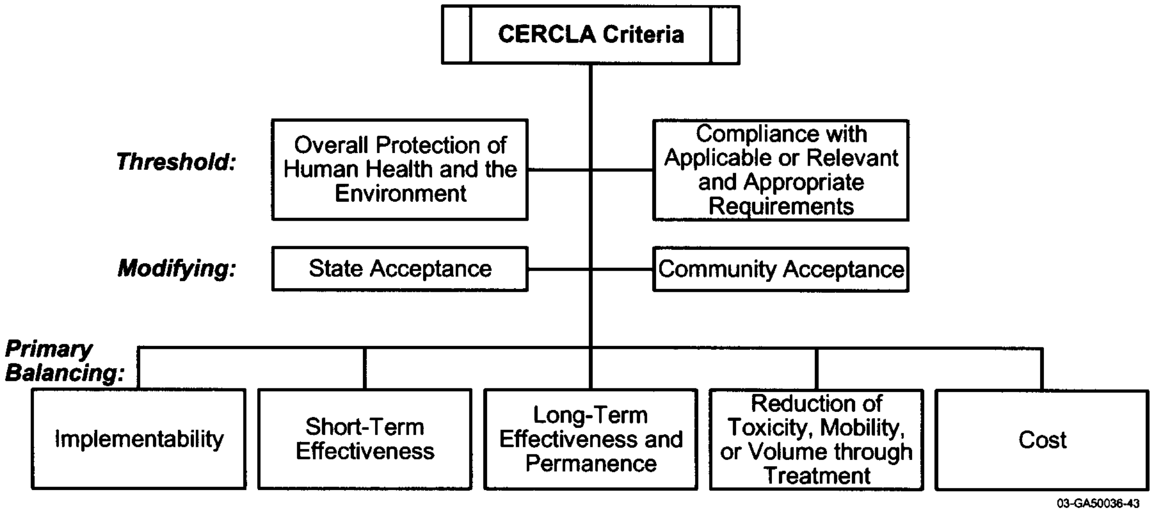


Figure 12. Comprehensive, Environmental Response, Compensation, and Liability Act criteria.

As previously discussed, the Agencies used a decision support model tailored for the V-Tanks. This model is based on the criteria identified in 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," and *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1998), which are the primary guidance documents for CERCLA. The CERCLA and the "National Oil and Hazardous Substances Pollution Contingency Plan" provide nine specified criteria, as shown in Figure 12 (40 CFR 300.430.[e][9][iii][F][1]). The CERCLA criteria are divided into three distinct groups: (1) modifying criteria, (2) threshold criteria, and (3) primary balancing criteria (40 CFR 300.430.[e][9][iii][F][1]). The modifying criteria (state and community acceptance) are not explicitly included in this decision analysis process until after the proposed plan has been released to the public for review. The threshold criteria, consisting of the overall protection of human health and the environment and compliance with ARARs, are criteria that all remedial alternatives must meet in order to be eligible for selection.

Using the "National Oil and Hazardous Substances Pollution Contingency Plan" and EPA guidance, subcriteria and evaluation measures (or value functions) are identified that allow quantitative evaluation of remedial alternative performance relative to each of the five primary balancing criteria. By applying weighting factors, the relative importance of each of these criteria is established. Scoring the remedial alternatives provides a ranking based on the criteria, subcriteria, weighting factors, and scores from the value functions. The model also allows a sensitivity analysis to be performed to determine the effects of evaluation measure score changes and changes to weighting factors on the remedial alternatives' ranking.

For the V-Tanks' decision support model, the Agencies decided to include an additional evaluation measure. A small number of other remedial actions at the INEEL have, or might, generate waste comparable to the V-Tanks and may be able to utilize the same treatment process. Three such waste streams were identified, and the ability of the various alternatives to treat these waste streams was added as an evaluation measure (see Section 5.6).

A discussion of each balancing criterion and the associated subcriterion follows. For each criterion or subcriterion, a value function is provided that correlates the performance measure (input parameter on the x-axis) to a normalized value (output value from 0 [worst] to 10 [best] on the y-axis).

5. IMPLEMENTABILITY (40 CFR 300.430 [e][9][iii][F]) and (EPA/540/G-89/004, § 6.2.3.6)

The implementability criterion addresses the technical feasibility, administrative feasibility, and the availability of various services and materials required to implement an alternative. Figure 13 shows the hierarchy of implementability within CERCLA. (Note: This hierarchy is only provided graphically for implementability, but exists for the other CERCLA criteria, as described in the following sections.)

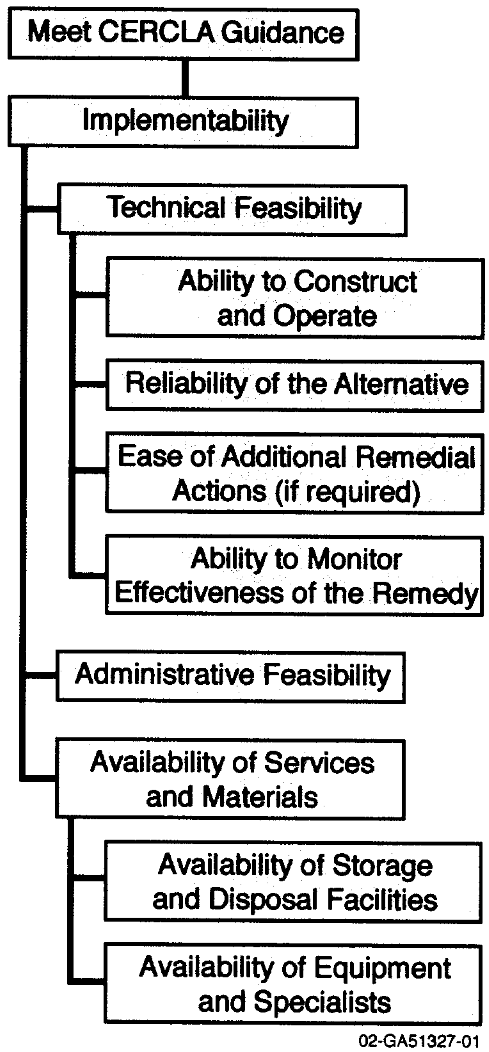


Figure 13. Hierarchy of implementability within the Comprehensive, Environmental Response, Compensation, and Liability Act.

5.1.1 Technical Feasibility (40 CFR 300.430 [e][9][iii][F][1]) and (EPA/540/G-89/004, § 6.2.3.6)

The CERCLA further subdivides technical feasibility into the subcriteria listed in Figure 13. These subcriteria are discussed in more detail in the following sections.

5.1.1.1 Ability to Construct and Operate. This subcriterion addresses the technical difficulties and unknowns associated with a technology. Decision-makers must consider the difficulties and uncertainties associated with construction and operation of the remedial alternatives being considered. Figure 14 shows the V-Tank area, illustrating the proximity to existing buildings at TAN.

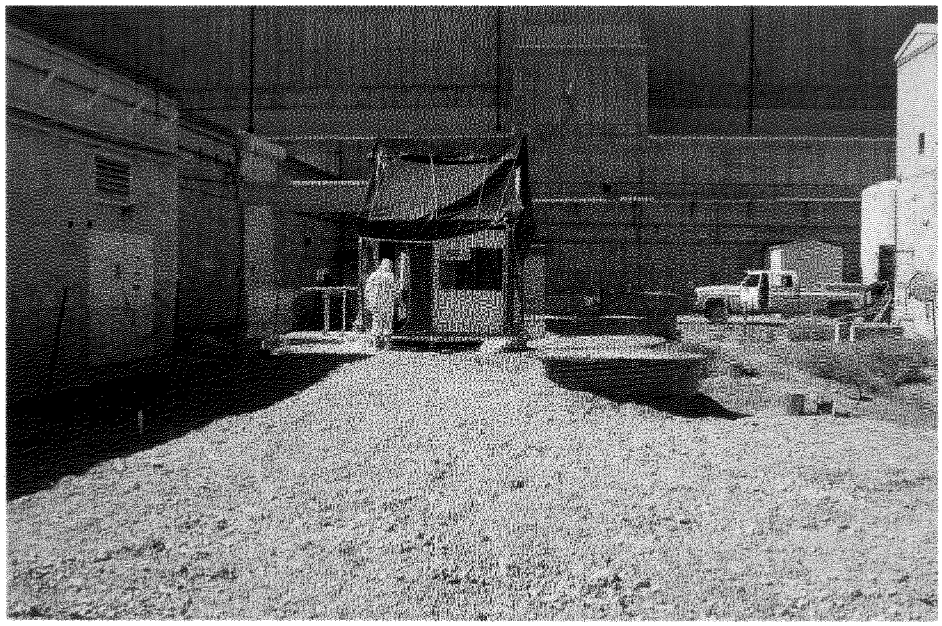


Figure 14. View of V-Tank area at Test Area North during Tank V-9 sampling (looking south).

For the alternatives under consideration, it was determined that an effective method for measuring the ability to construct and operate was to evaluate the technology's maturity. Figure 15 shows the value function for this metric. For the purposes of this technology evaluation, the following definitions of technology maturity were used:

- Research—performed either as a paper study or bench-scale test, performed with respect to any comparable media
- Development—performed bench-scale or pilot-scale, performed on soil or sludge, used surrogates for key contaminants
- Demonstration—performed on a scale sufficient to prove the concept for implementation, performed on soil or sludge, used some contaminants
- Used in Similar Application—performed in same environment (e.g., if in situ, in a tank), used same media, used some contaminants (e.g., hazardous not radioactive)
- Used Routinely—performed routinely either commercially or within the DOE complex, used many of the same contaminants.

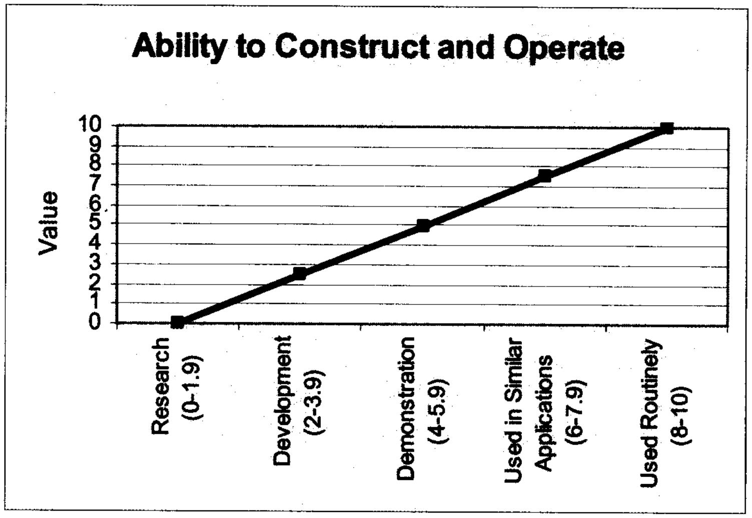


Figure 15. Ability to construct and operate.

5.1.1.2 Reliability of the Alternative. This subcriterion addresses the likelihood that technical problems associated with implementation will lead to schedule delays. A metric for a given process's number of major components was determined to be appropriate, using the logic that the more components there are, the more likely technical problems will occur that could result in schedule delays. Figure 16 shows the value function for this metric.

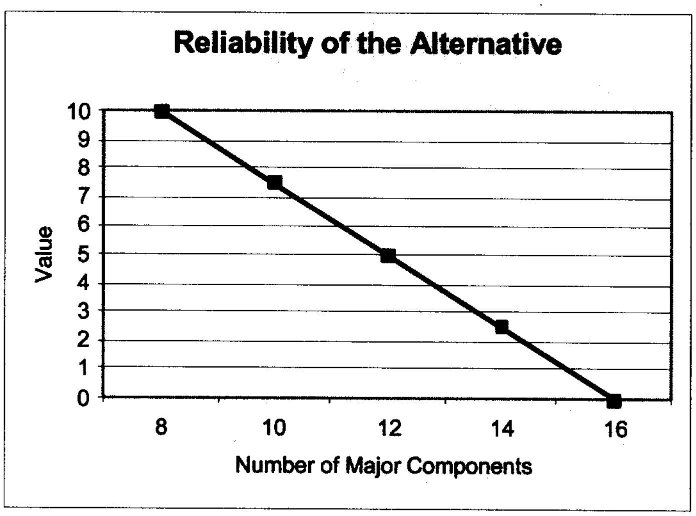


Figure 16. Reliability of the alternative.

5.1.1.3 Ease of Additional Remedial Actions. This subcriterion addresses future remedial actions that might need to be undertaken and how difficult it would be to implement such additional actions. Since V-Tank remediation will result in clean closure, this is interpreted to mean recovery if initial treatment does not meet RAOs. If immediate recovery were possible using the same technology, then the alternative would receive a high rating (10). On the other hand, the situation might be recoverable by changing a parameter within the alternative (e.g., temperature or a chemical mix). Under these circumstances, the alternative might receive a rating of 8. If it were not possible to recover using the same technology, the alternative would receive a rating of 0. Figure 17 shows the value function for this metric.

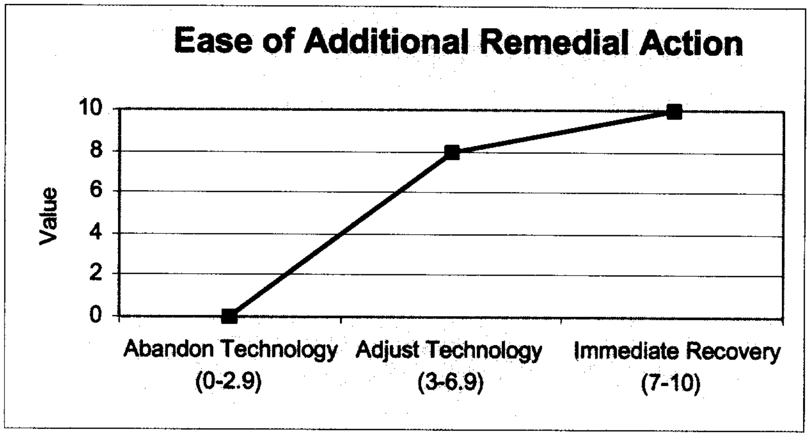


Figure 17. Ease of additional remedial action.

5.1.1.4 Ability to Monitor the Effectiveness of the Remedy. This subcriterion addresses the ability to monitor the remedy's effectiveness and includes an evaluation of the exposure risks, should monitoring be insufficient to detect a system failure. Since the V-Tanks' remedial action will result in clean closure, this criterion applies to monitoring the V-Tanks and surrounding area during the remedial actions. The metric addresses the risks, should monitoring be insufficient. Figure 18 shows the value function for this metric and the potentially impacted receptors.

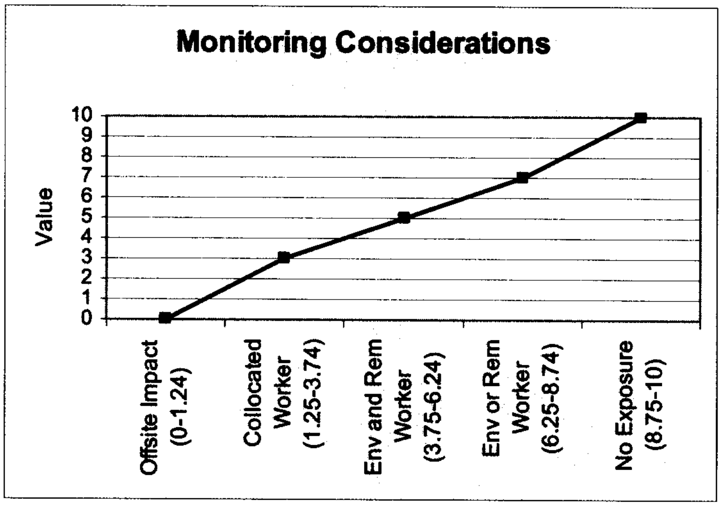


Figure 18. Monitoring considerations.

5.1.2 Administrative Feasibility (40 CFR 300.430 [e][9][iii][F][1]) and (EPA/540/G-89/004, § 6.2.3.6)

This subcriterion addresses the feasibility of obtaining both internal and external administrative approval to proceed with each proposed technology at the INEEL. The administrative feasibility subcriterion is associated with administrative approvals from INEEL management, as well as the Agencies involved in environmental remediation decision-making at the INEEL (DOE-ID, IDEQ, and EPA Region 10) and other agencies involved in off-Site disposal decisions (as applicable).

To facilitate the determination of each technology's administrative feasibility rating, a metric was developed based on five major administrative processes and their estimated complexity for each of the seven technologies under consideration. The five major administrative processes include:

- Completing the safety analysis documentation for the proposed technology
- Completing the operational readiness (OR) process for the proposed technology
- Obtaining regulatory approval for each technology as an acceptable alternative for retorting mercury (if applicable)
- Obtaining regulatory approval for each technology as an alternative process for PCB destruction (if applicable)
- Obtaining approval for off-Site disposal of the primary waste stream, after treatment (if applicable).

Each proposed technology will be assigned a level of complexity between 0 and 1 (in 0.25 increments), for each of these major administrative processes (0 = not applicable, 0.25 = minor, 0.5 = moderate, 0.75 = major, and 1.0 = extreme). Then, the sum of these complexities will be added up to define a total administrative feasibility complexity input value, between 0 and 5, for each proposed technology. These input values will be applied to the inverse-linear curve shown in Figure 19.

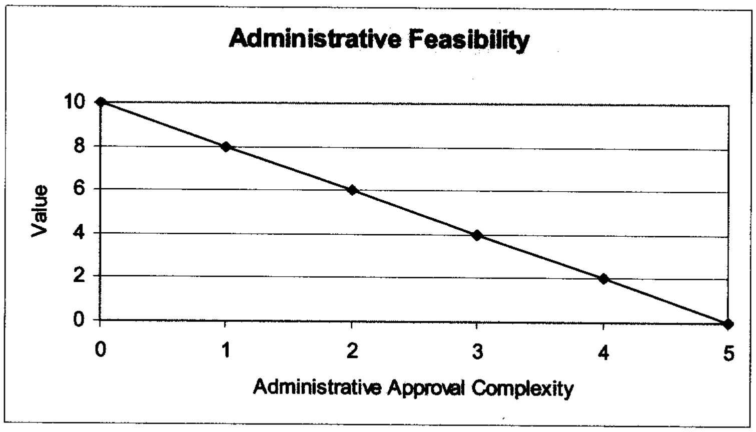


Figure 19. Administrative feasibility.

Chemical oxidation/reduction is an example of a remedial alternative impacted by this criterion. For example, applicable regulations require incineration for the treatment of PCBs. Conventional in situ vitrification is considered an acceptable alternative to incineration, but chemical oxidation/reduction will require a risk-based equivalency petition. Other examples of activities that might require additional administrative approvals include obtaining special permission for disposal of hazardous waste at other DOE facilities that are currently not accepting these waste types from out of state.

5.1.3 Availability of Services and Materials (40 CFR 300.430 [e][9][iii][F][1]) and (EPA/540/G-89/004, § 6.2.3.6)

Availability of services and materials directly affects whether a remedial alternative can be implemented. This criterion addresses the availability of services—such as treatment capability, storage capacity, disposal services, and the availability of necessary equipment and specialists—and the availability of prospective technologies, including the potential for obtaining competitive bids.

5.1.3.1 Availability of Treatment, Storage, and Disposal Facilities.

5.1.3.1 Availability of Treatment, Storage, and Disposal Facilities. This subcriterion directly addresses the availability of TSDFs for remediation alternatives that require them. As noted in Section 2, several disposal facilities are not currently accepting out-of-state mixed waste, which influences the decision to produce a waste stream that relies on this acceptance being forthcoming. Figure 20 shows the value function of this metric.

The Agencies agreed that a factor would be applied to this metric to adjust for the amount of control the INEEL has over the TSDFs planned for the various alternatives. If the INEEL has control over TSDFs, a control factor multiplier of 1 was used. If the INEEL has control over either treatment, storage or disposal, a control factor multiplier of 0.8 was used. If the INEEL has no control of the treatment, storage or disposal facilities, a control factor multiplier of 0.6 was used. Figure 21 shows the control factor for this metric.

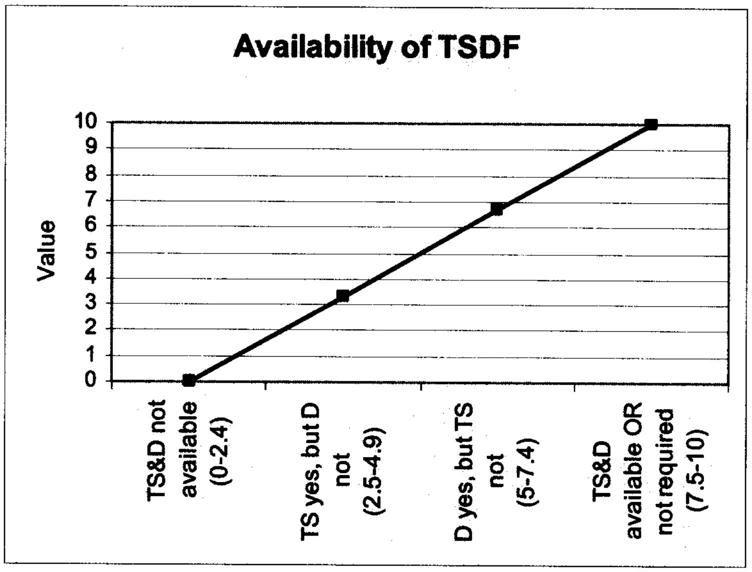


Figure 20. Availability of treatment, storage, and disposal facility.

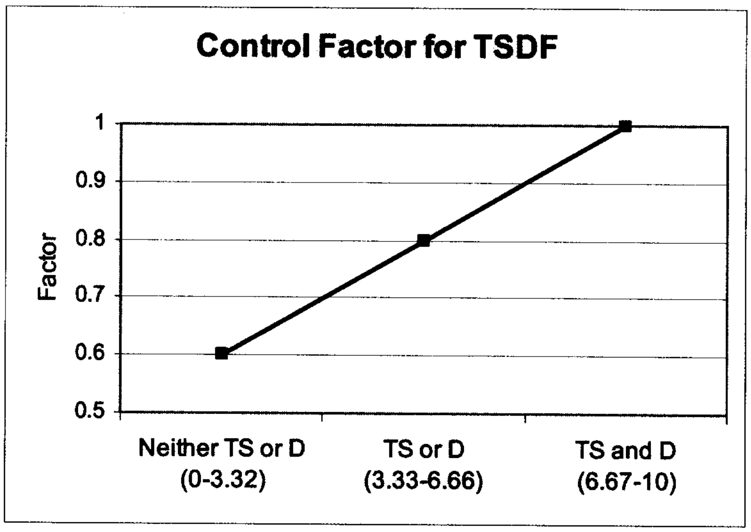


Figure 21. Control factor for treatment, storage, and disposal facility.

5.1.3.2 ***Availability of Equipment and Specialists.*** This subcriterion addresses the availability of necessary equipment and specialists, and it addresses provisions to ensure that any necessary additional resources will be available. One of the metrics that was considered was the number of subcontractors available for each remedial alternative. However, it was determined that the level of confidence in a vendor's ability to implement the remedial alternative was more appropriate. Figure 22 shows the value function for this metric. The confidence rating also will consider whether the alternative has been used in a radiological environment and whether the potential vendor has previous DOE experience.

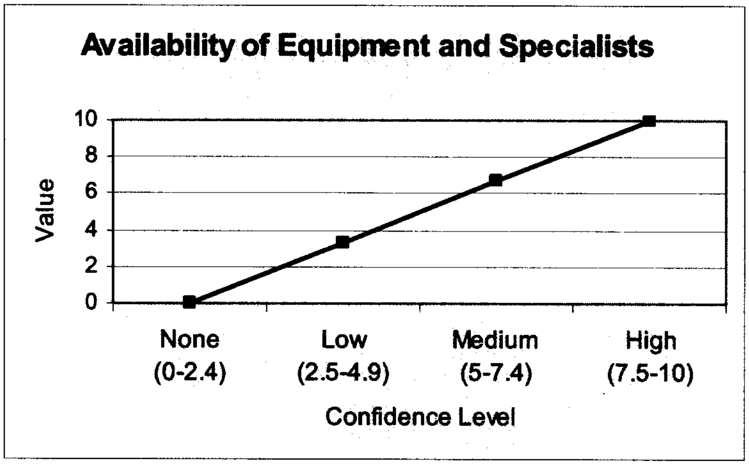


Figure 22. Availability of equipment and specialists.

Another related subcriterion under Availability of Services and Materials is the availability of prospective technologies. This criterion also addresses the technology's maturity and the vendors available to implement the technology. However, it was decided that the metrics for this criterion are already being addressed under Technical Feasibility, Ability to Construct and Operate, Availability of Services and Materials, and Availability of Necessary Equipment and Specialists.

5.2 Short-Term Effectiveness (40 CFR 300.430 [e][9][iii][E]) and (EPA/540/G-89/004, § 6–9)

This evaluation criterion addresses the alternative's effects on human health and the environment during the construction and implementation phase until the remedial response objectives have been met. The following should be addressed, as appropriate, for each alternative: (1) protection of the community during remedial actions, (2) protection of workers during remedial actions, (3) environmental impacts, and (4) the length of time until remedial response objectives are achieved.

5.2.1 Length of Time to Remediate (EPA/540/G-89/004, § 6–9) and (40 CFR 300.430 [e][9][iii][E][4])

This subcriterion includes an estimate of the time required to remediate the tank waste and remediate the entire site, including disposition of all associated waste streams. Two metrics were developed to depict these durations. The first metric, in Figure 23, is the value function for the time from approval of the amended ROD until the tank waste is treated and retrieved or is in stable form (in the case of in situ treatments). The second metric, in Figure 24, is the value function for the time to achieve site closure, including disposition of all associated waste streams. This is defined as the time from approval of the amended ROD to when the ROD is fully implemented.

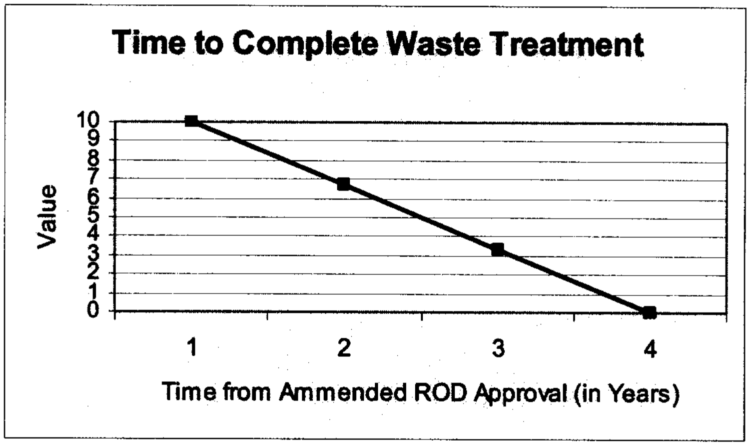


Figure 23. Time to complete waste treatment.

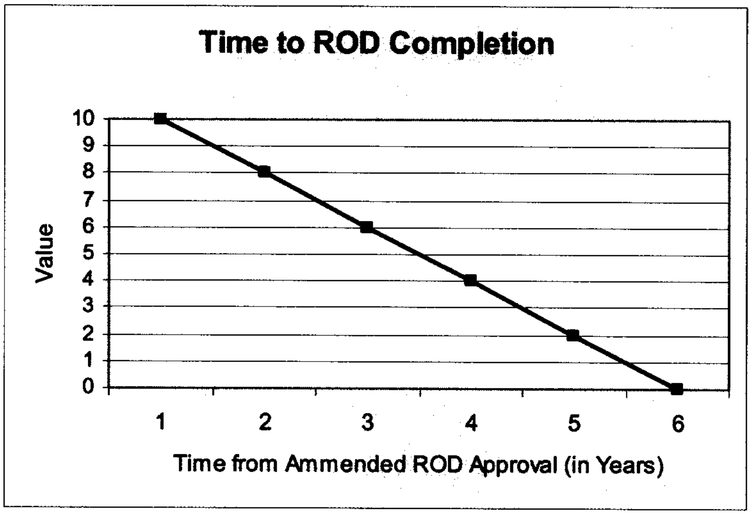


Figure 24. Time to Record of Decision completion.

5.2.2 Community Protection (40 CFR 300.430 [e][9][iii][E][1]) and (EPA/540/G-89/004, §6–9)

This subcriterion satisfies the CERCLA requirement to address protection of the surrounding community during the remedial action.

The INEEL's vast expanse makes the probability extremely low that any project hazards will affect anyone off-Site. Therefore, it was determined that shipping contaminated waste off-Site gives the highest potential for exposure to the community. Thus, the metric addresses whether treated or untreated waste (some or all) is transported off the INEEL. Figure 25 shows the value function for this metric.

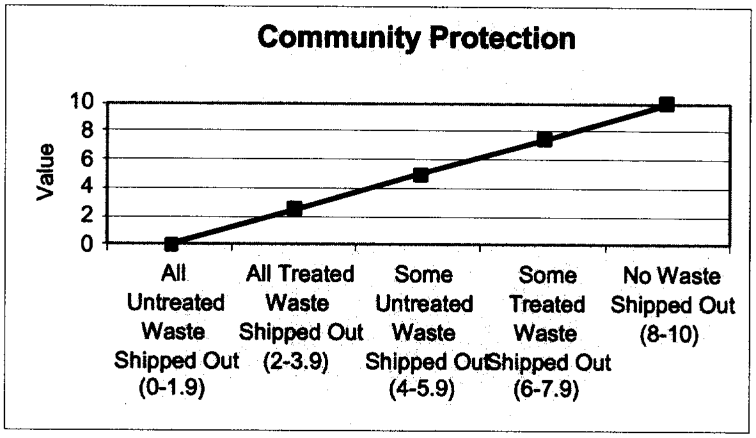


Figure 25. Community protection.

5.2.3 Worker Protection (40 CFR 300.430 [e][9][iii][E][2]) and (EPA/540/G-89/004, §6–9)

This subcriterion satisfies the CERCLA requirement to address protection of workers during the remedial action. This factor assesses threats that might be posed to workers and the effectiveness and reliability of protective measures that would be taken.

Figure 26 shows the value function for this metric. The metric addresses the remediation worker, as opposed to a collocated worker. In addition, the rating must consider the entire process, not just treatment exposure risks. Seven worker hazards were considered in developing the metric: (1) confined space entry, (2) radiological, (3) industrial, (4) potential fire/explosion, (5) hazardous chemical, (6) airborne contaminant, and (7) electrical hazard. As with some previous measures, a "complexity factor" was assigned to this measure to address the difficulty involved in mitigating some of the technology-specific hazards (see Figure 27).

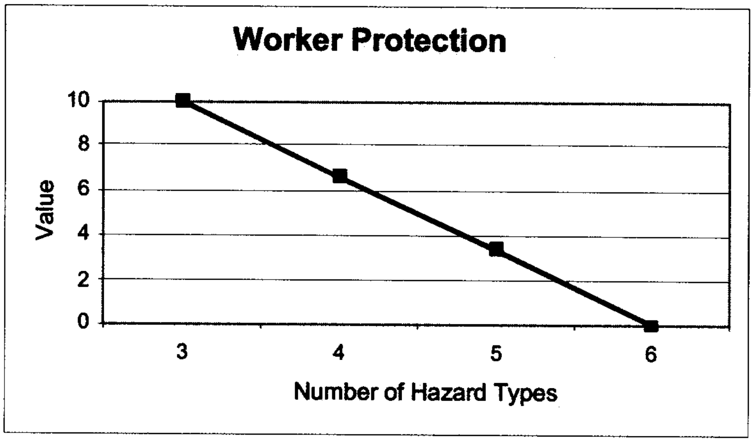


Figure 26. Worker protection.

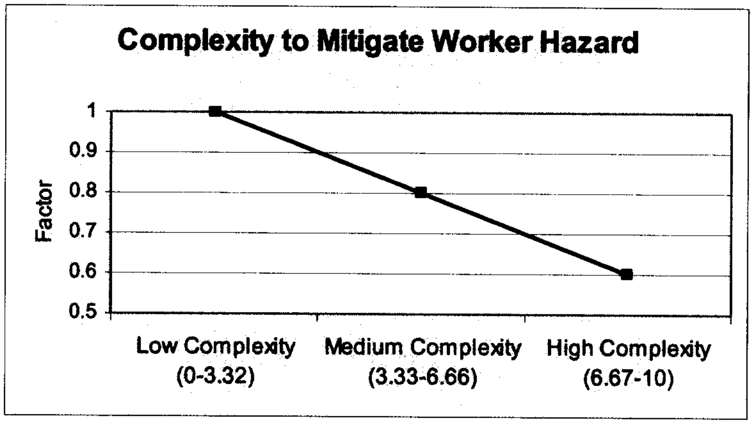


Figure 27. Complexity to mitigate worker hazard.

5.2.4 Environmental Impacts (40 CFR 300.430 [e][9][iii][E][3]) and (EPA/540/G-89/004, § 6–9)

This subcriterion satisfies the CERCLA requirement to address the potential for adverse environmental impacts that could result from the construction and implementation of a remedial alternative. It focuses on the most important issue—endangered species. The worst outcome is selecting an alternative that has an impact on endangered species. (It is assumed that all of the alternatives will have the same score [no impact] for V-Tank remediation, but the criterion is kept to show that it was considered.) The measure has two categories: (1) plants and (2) animals. Figure 28 shows the value function of the plant impact metric. Figure 29 shows the value function of the animal impact metric.

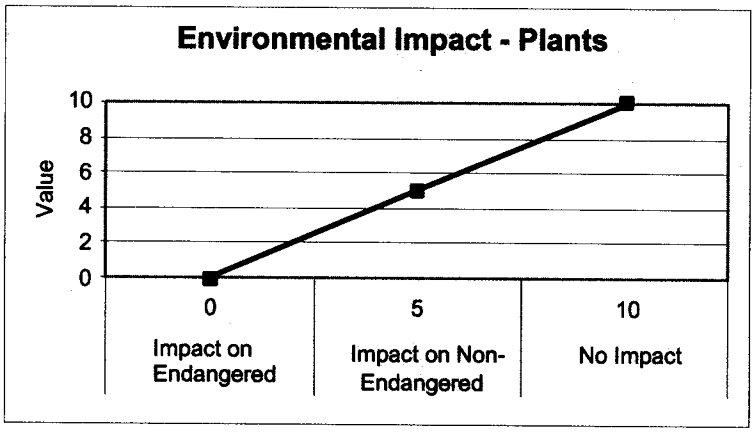


Figure 28. Environmental impact—plants.

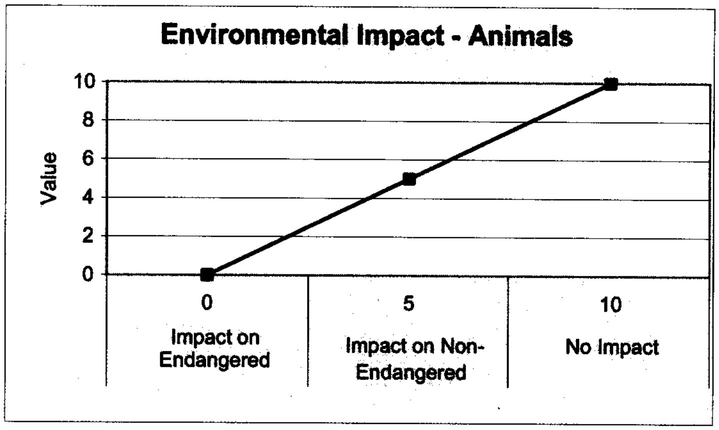


Figure 29. Environmental impact—animals.

5.3 Long-Term Effectiveness and Permanence (40 CFR 300.430 [e][9][iii][F]) and (EPA/540/G-89/004, § 6.2.3.3)

This criterion addresses the results of a remedial action in terms of the risk remaining at the site after response objectives have been met. The evaluation's primary focus is the extent and effectiveness of the controls that could be required to manage the risk posed by treatment residuals and/or untreated waste. The following subcriteria address the magnitude of residual risk and adequacy and reliability of controls.

5.3.1 Magnitude of Residual Risk (40 CFR 300.430 [e][9][iii][F][1]) and (EPA/540/G-89/004, § 6–8)

This subcriterion assesses the residual risk remaining from untreated waste or treatment residuals at the conclusion of remedial activities. The potential for this risk can be measured by numerical standards, such as cancer risk levels or the volume or concentration of contaminants in waste, media, or treatment residuals remaining on the site. The characteristics of the residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate. Figure 30 shows the value function for this metric. (Because each of the V-Tank remedial alternatives results in clean closure, this metric will not distinguish between alternatives.)

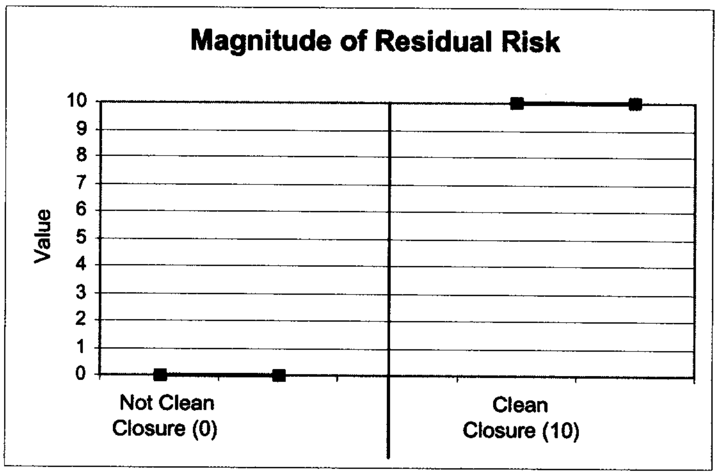


Figure 30. Magnitude of residual risk.

5.3.2 Adequacy and Reliability of Controls (40 CFR 300.430 [e][9][iii][C][2]) and (EPA/540/G-89/004, § 6–9)

The CERCLA guidance addresses the adequacy and reliability of controls used to manage treatment residuals or untreated waste that remains at the site. It also addresses the potential need for replacement of technical components, magnitude of threats or risks should the remedial action need replacement, and degree of confidence that controls adequately handle potential problems over the long term. Figure 31 shows the value function for this metric. (Again, because each alternative achieves clean closure, this metric will not distinguish between alternatives.)

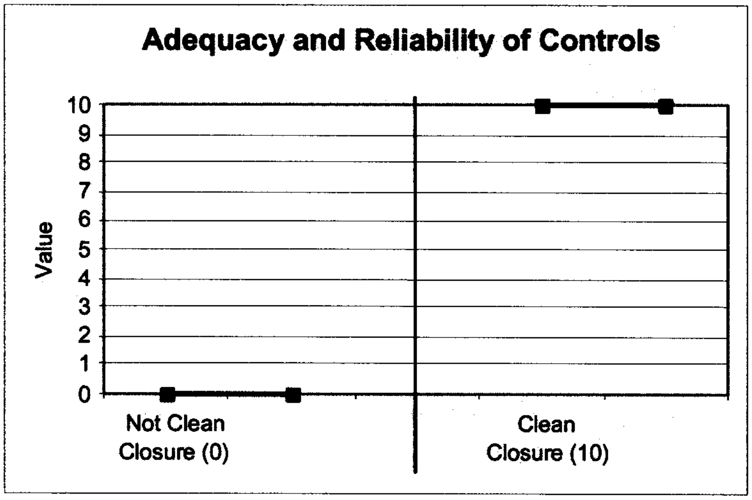


Figure 31. Adequacy and reliability of controls.

5.4 Reduction of Toxicity, Mobility, and Volume through Treatment (40 CFR 300.430 [e][9][iii][D]) and (EPA/540/G-89/004, § 6.2.3.4)

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce TMV of the hazardous substances.

Since the ROD directs removal of tank contents, the principal threat was considered to be Cs-137-contaminated soil surrounding the tanks. A formal risk assessment has been performed on the Cs-137-contaminated soil. The contaminants associated with tank contents will present no residual risk after removal and treatment for all alternatives being evaluated. However, it was determined that the tank content contaminants were an important evaluation consideration in terms of treatment and disposal. Based on a review of these contaminants and their fate during treatment and disposal, the following key CFTs were identified: (1) TRU, (2) cadmium, (3) lead, (4) mercury, (5) TCE, (6) PCBs, and (7) BEHP.

5.4.1 The Amount of Hazardous Materials Destroyed or Treated (40 CFR 300.430 [e][9][iii][D][3]) and (EPA/540/G-89/004, § 6.2.3.4)

This subcriterion satisfies the CERCLA requirement to address the amount of hazardous material destroyed or treated. It addresses primary treatment and primary waste volume only. There is a separate category for residual waste treatment (see Section 4.5.4).

Figure 32 shows the value function for primary waste volume. This volume measurement includes the treated contents of the tanks, the reagents or soil added during the treatment process, and the surrounding soil and tanks. Although separate metrics for each of these components could have been used, the soil and tank volumes generally are comparable across all alternatives and tend not to provide a clear means to distinguish among alternatives. However, for completeness, their volume is included in this metric.

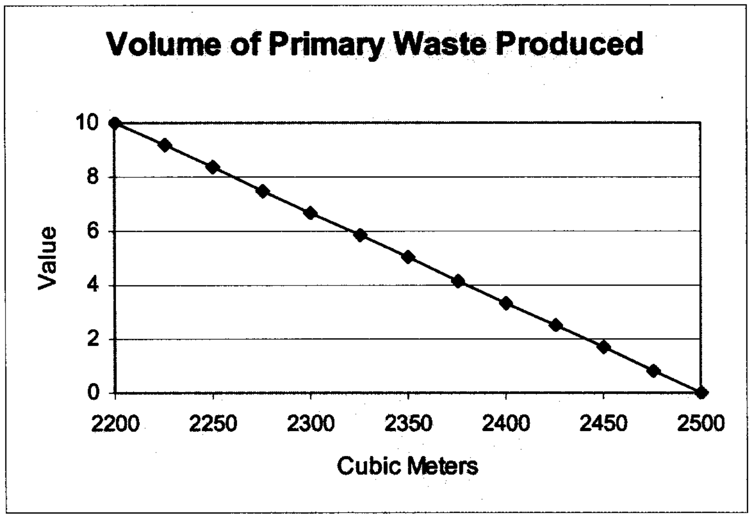


Figure 32. Volume of primary waste produced.

It is assumed that the concentration in the final waste form, after all necessary treatments, will be used to establish a CFT's final concentration. Based on samples of the tank contents, the V-Tank waste is assumed to be characteristically hazardous. This invokes applicable underlying hazardous constituents and the associated universal treatment standards (UTSs). (Note: Additional sampling could prove this assumption is in error.) Therefore, the following remediation goals were identified to meet regulatory limits and the waste acceptance criteria of the applicable disposal facility(ies):

- Transuranics—<10 nCi/g (ICDF waste acceptance criteria); 10–100 nCi/g (NTS or Hanford waste acceptance criteria); >100 nCi/g (WIPP waste acceptance criteria)
- Cadmium (TCLP)—0.11 mg/L (UTSs)
- Lead (TCLP)—0.75 mg/L (UTSs)
- Mercury (TCLP)—0.025 mg/L (UTSs)
- TCE—6 mg/kg (UTSs)
- PCBs—10 mg/kg (UTSs)
- BEHP—28 mg/kg (UTSs).

Figure 33 shows the metric's value function for the TRU concentration in the primary waste after all treatments. A TRU concentration less than 10 nCi/g was given a score of 10, since more disposal options are available and the TRU levels are reduced. The next best option is disposal at the WIPP, since it is operational and INEEL waste is already being shipped there. Thus, if waste were concentrated to greater than 100 nCi/g, it would receive a score of 9. Finally, if the concentration is between 10 and 100 nCi/g, the waste would receive a score varying from 8 to 9. This is based on the assumption that the NTS and Hanford will be accepting out-of-state mixed waste by 2007.

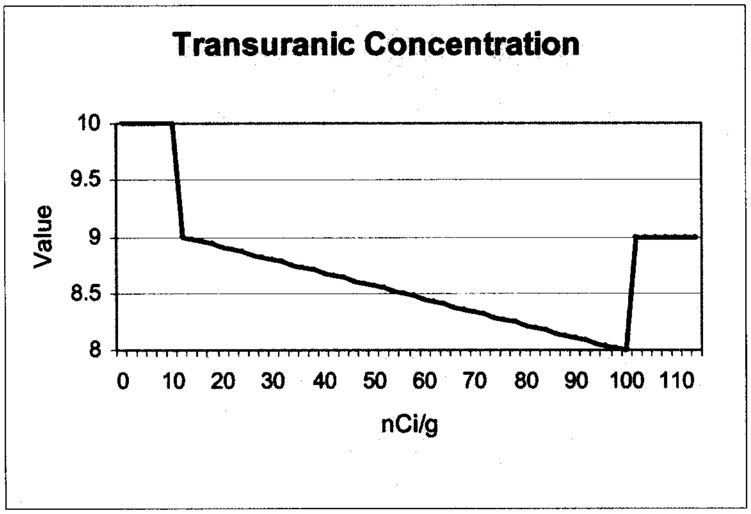


Figure 33. Transuranic concentration.

Figures 34–39 show the value functions for reduction in toxicity and/or mobility of cadmium, lead, mercury, TCE, PCBs, and BEHP. The scale for each value function metric is an inverse log scale, covering two orders of magnitude, with the lower scale defined as the LDR concentration (or leachate value) and the higher scale defined as 1% of the LDR concentration (or leachate value). The value functions chosen for these measures produce the following: (1) an output score of 10 (best) if the proposed technology system results in a TCLP or total concentration at least two orders of magnitude lower than the LDR limit; (2) an output score of 5 if the proposed technology results in a TCLP or total concentration one order of magnitude below LDR limits; and (3) an output score of 0 (worst) if the proposed technology is not expected to meet LDRs. Input values for each technology system were determined by estimating the resulting concentration (or leachate value) for each identified contaminant, following treatment.

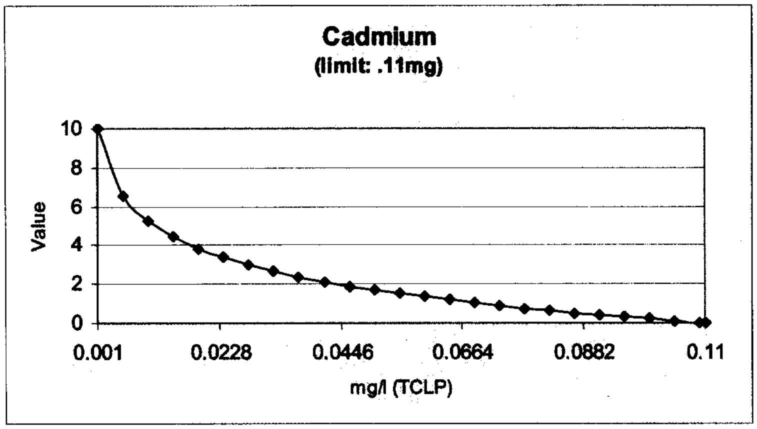


Figure 34. Cadmium.

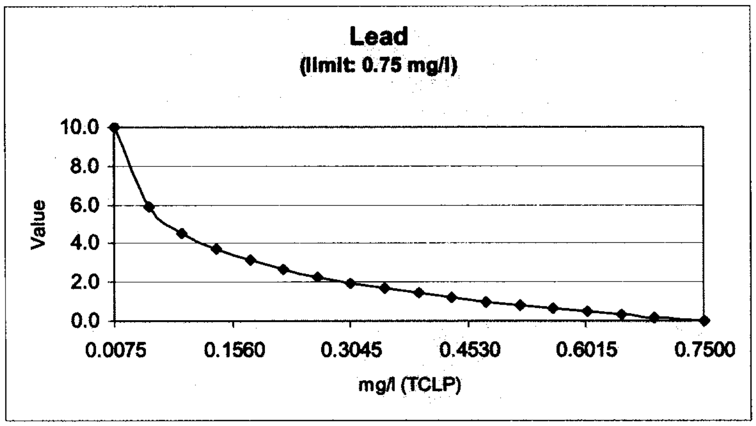


Figure 35. Lead.

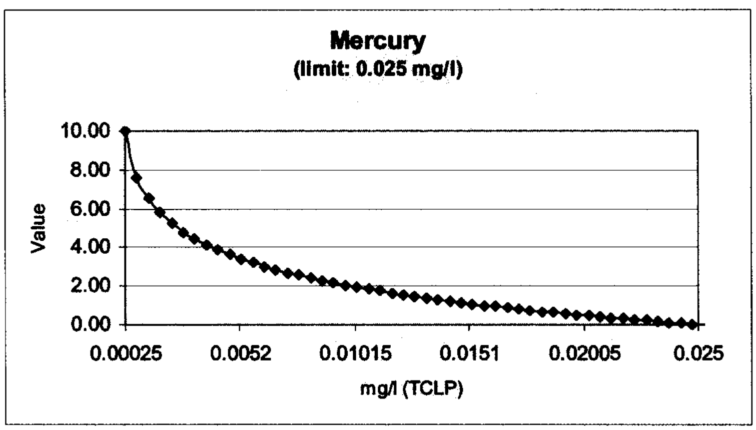


Figure 36. Mercury.

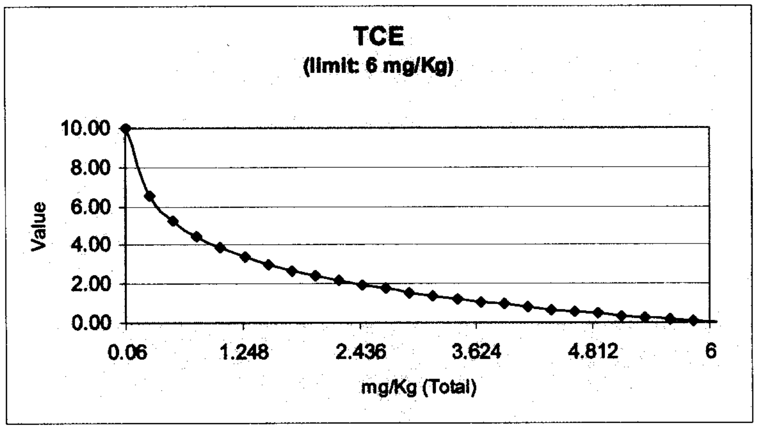


Figure 37. Trichloroethylene.

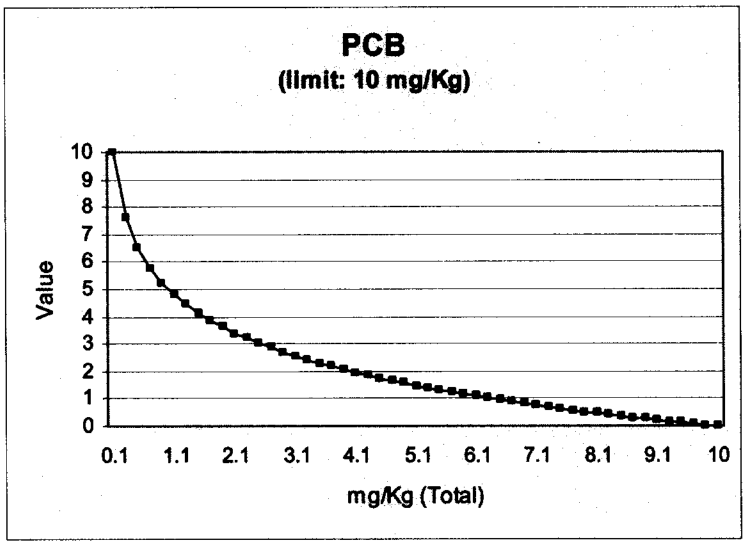


Figure 38. Polychlorinated biphenyl.

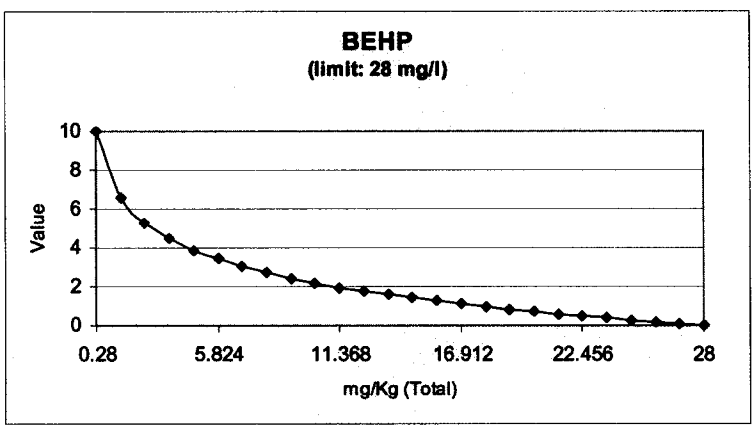


Figure 39. Bis(2-ethylhexyl)phthalate.

5.4.2 Amount of Principal Threat Treated to Reduce Toxicity, Mobility, or Volume (40 CFR 300.430 [e][9][iii][D][3]) and (EPA/540/G-89/004, § 6.2.3.4)

This subcriterion satisfies the CERCLA requirement to address the degree of expected reduction in TMV of the principal threat (Cs-137) in the soil surrounding the tanks. The final remediation goal for Cs-137 is 23.3 pCi/g. If levels above this limit are found during soil removal at depths that provide a credible pathway to potential receptors, additional soil will be removed until this limit is achieved. Figure 40 shows the value function for this metric. (Since all alternatives for the V-Tanks will result in clean closure, this subcriterion will not distinguish between alternatives.)

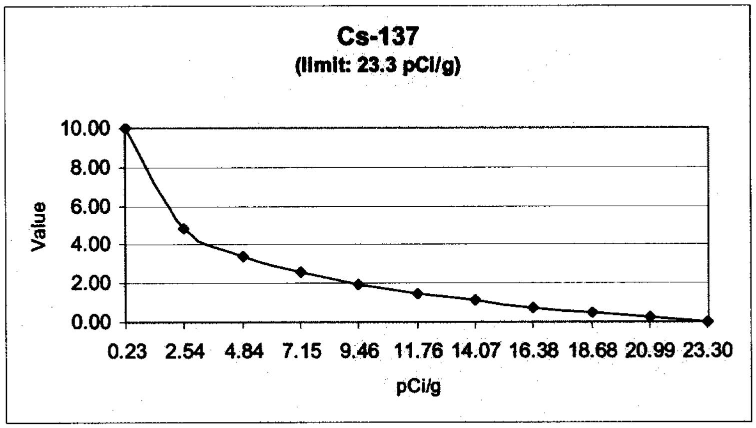


Figure 40. Cesium-137.

5.4.3 Irreversibility of Treatment of Contaminants (40 CFR 300.430 [e][9][iii][D][3]) and (EPA/540/G-89/004, § 6.2.3.4)

This subcriterion satisfies the CERCLA requirement to address the irreversibility of the reduction in contaminant mobility and toxicity. For these alternatives, reversing toxicity is not applicable. This evaluation measure focuses on the mobility's reversibility (in the form of leachability) of the treated waste due to natural degradation. Figure 41 shows the value function for this metric.

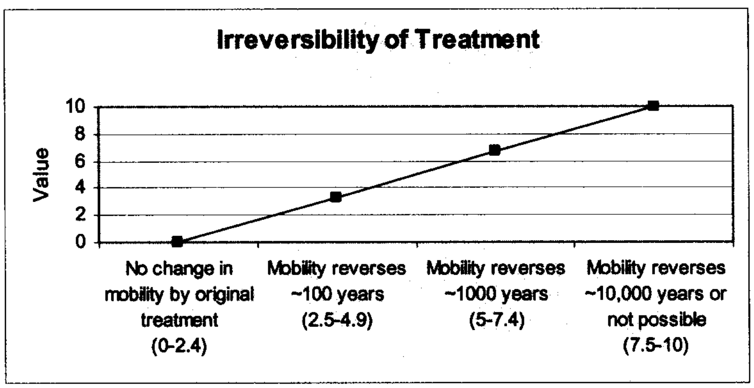


Figure 41. Irreversibility of treatment.

5.4.4 Amount of Treatment Residuals Remaining after Treatment (40 CFR 300.430 [e][9][iii][D][3]) and (EPA/540/G-89/004, § 6.2.3.4).

This subcriterion satisfies the CERCLA requirement to address the quantity and characteristics of treatment residuals (secondary waste). Included in this category are the following waste types: contaminated equipment, spent filters, used personal protective equipment, etc. For the V-Tanks, the Agencies agreed at a meeting held on August 26, 2002, to only look at the volume of secondary waste, not the characteristics. Although the characteristics may vary somewhat between alternatives, the waste volume was considered the key metric and other criterion (such as disposal costs) would tend to address the contaminant treatment and disposal issues. Figure 42 shows the value function for this metric.

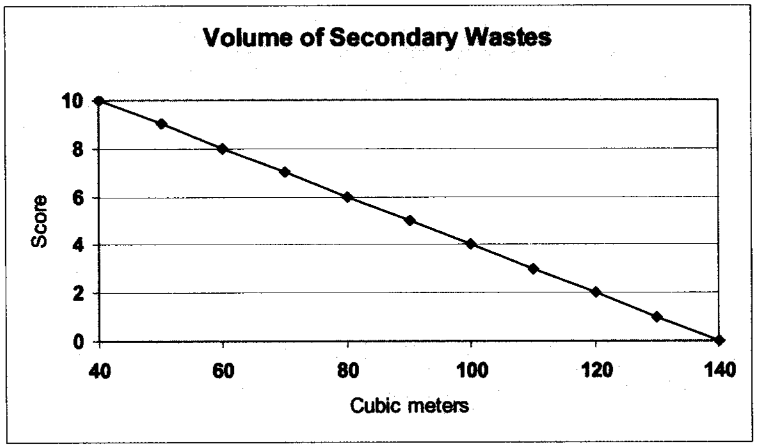


Figure 42. Volume of secondary waste.

5.5 Cost

The CERCLA (42 USC § 9601 et seq.) and 40 CFR 300.430 (e)(9)(iii)(G) state that this criterion must account for capital cost, operations and management cost, and present worth (EPA 1998). For this metric, life-cycle costs (without escalation) were discounted to net present value.

Cost is defined for the life cycle of the entire V-Tank Project. This includes costs for treatment, transportation, storage, and disposal. The costs include primary treatment, soil remediation and removal, pipe removal, tank removal, processing of secondary waste, sampling and analysis, interim storage, shipping, disposal, site restoration, safety analysis, work authorization, contingency, and other associated costs. Historical costs incurred to date since issuance of the original ROD also are included. As illustrated in Figure 43, the value function for cost assigns the lowest value to the highest life-cycle cost alternative.

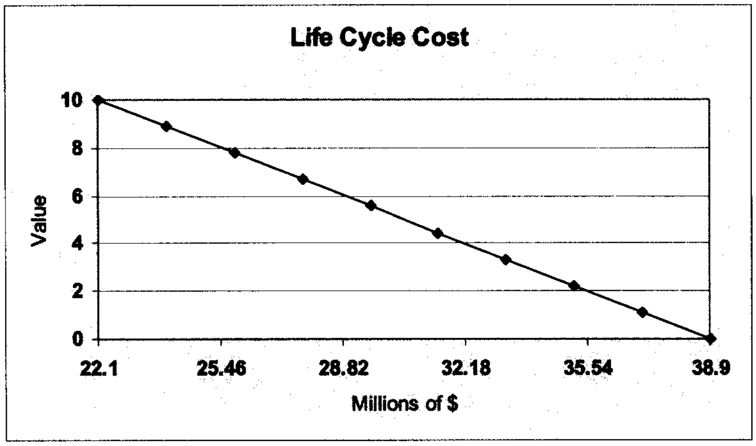


Figure 43. Life-cycle cost.

5.6 Applicability to Other Idaho National Engineering and Environmental Laboratory Comprehensive, Environmental Response, Compensation, and Liability Act Waste Streams

This criterion is not part of the formal CERCLA process, but was included in the V-Tanks' analysis as an efficiency measure endorsed by the Agencies. Typically, the CERCLA process is applied at a specific site, and it does not consider ramifications to other sites. At the INEEL, there are many CERCLA sites, and each is nominally considered separately. The DOE-ID, EPA, and IDEQ want to be proactive in evaluating potential efficiencies for the INEEL. Thus, a criterion was added to this evaluation to assess whether the treatment alternative for the V-Tanks could have potential applicability toward other INEEL CERCLA waste streams.

Three CERCLA waste streams were identified that could potentially be treated in the same manner as V-Tank waste. These waste streams include waste from a tank at the Auxiliary Reactor Area (ARA), ARA-16; the PM-2A tanks at TAN; and investigation-derived waste from previous CERCLA work at TAN.

The ARA-16 tank was a 1,000-gal stainless-steel underground holding tank resting within a concrete vault and covered by approximately 3.5 ft of soil. From 1959 to 1988, the tank received radioactive liquid waste, including wash water from hot cells, methanol, acetone, chlorinated paraffin, and mixed acids from material testing and research and metal-etching processes. Periodically, the contents of the tank were emptied into a tank truck and transported to INTEC (formerly known as the Idaho Chemical Processing Plant) for disposal on an as-needed basis.

The ARA-16 facility was formally shut down in 1988, and the tank was partially excavated. All lines into and out of the tank were later cut and capped, and the tanks' contents were agitated and pumped out through a sludge high-integrity container (with internal filter) to separate the liquid and solid phases. The liquid has been treated and is planned for disposal at the ICDF. However, the sludge phase (representing less than 100 gal) remains untreated. It also was destined for treatment and disposal at the ATG. Through sampling results and anecdotal information, the waste was identified as containing F-listed mixed waste along with TRU elements (DOE-ID 1999b).

The PM-2A tank site (TSF-26) at TAN consists of two abandoned 50,000-gal underground storage tanks and the contaminated surface soil around them. The total waste volume currently in these tanks is estimated to be 8,000 gal. The tanks are approximately 15 ft below ground surface and rest in concrete cradles. The tanks were installed in the mid-1950s and stored concentrated low-level radioactive waste from the TAN-616 evaporator from 1955–1981. Currently, the tanks contain sludge contaminated with radionuclides, heavy metals, organic compounds, and PCBs. These tanks' primary sludge source was from the V-Tanks that collected this waste from various TAN sources. No liquids are present in the PM-2A tanks, because, in 1981, the tanks were partially filled with material to absorb free liquid (DOE-ID 1999a).

Investigation-derived waste includes items such as used equipment, glass, personal protective equipment (PPE), and sample residue directly associated with V-Tank activities. The gross volume of this waste is 924 ft^3. The majority of this waste is stored at TAN in CERCLA storage areas, but there are also containers of this waste stored in RCRA-permitted storage facilities at the Waste Reduction Operations Complex. The waste is containerized in a variety of drums and wooden boxes.

Currently, there are four other CERCLA-managed waste streams associated with other Waste Area Group 1 waste activities at TAN, in addition to the V-Tank investigation-derived waste. The gross volume of this investigation-derived waste is 625 ft^3. The waste is composed of soil, PPE, and other debris generated from sampling activities at various Waste Area Group 1 locations. This waste is stored at TAN in CERCLA storage areas and at the Waste Reduction Operations Complex and INTEC in RCRA-permitted storage facilities. The waste is containerized in a variety of drums and wooden boxes.

Figures 44, 45, and 46 show the value functions used to rate the alternatives for applicability to treatment of other waste. Each waste stream is considered to have equal weighting. All three value functions are differentiated based on whether the alternative cannot be used for the waste stream, can be used but some adaptation of the technology is required, or can be easily adapted for use on that waste stream.

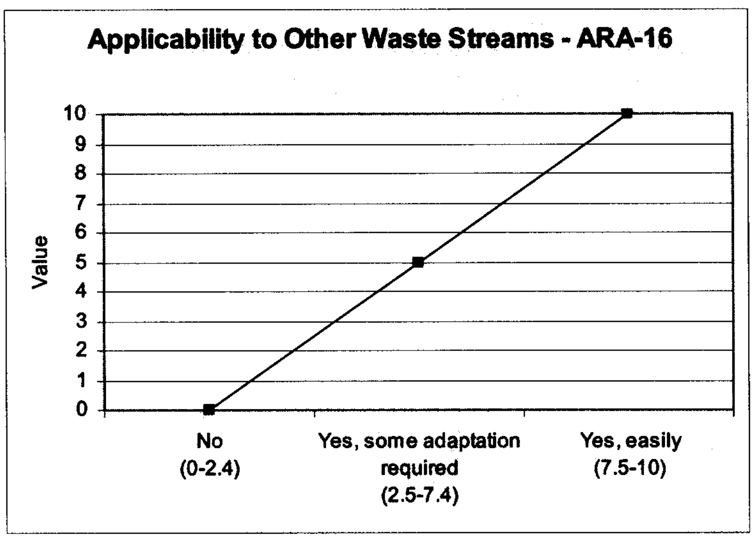


Figure 44. Applicability to other waste streams—ARA-16.

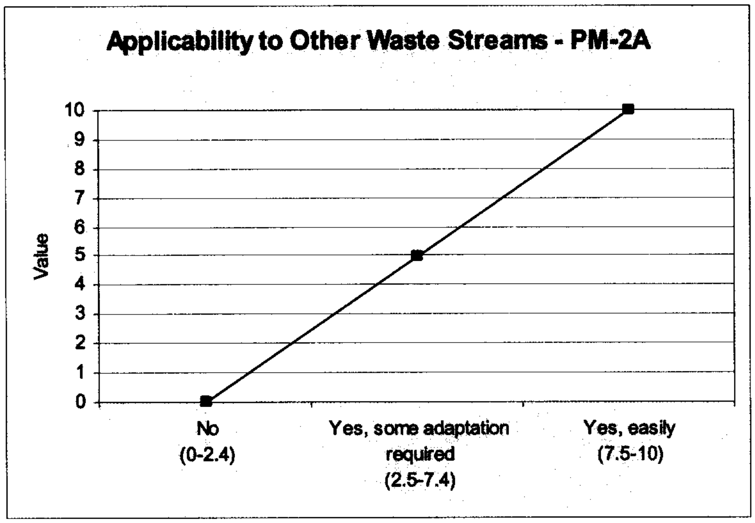


Figure 45. Applicability to other waste streams—PM-2A.

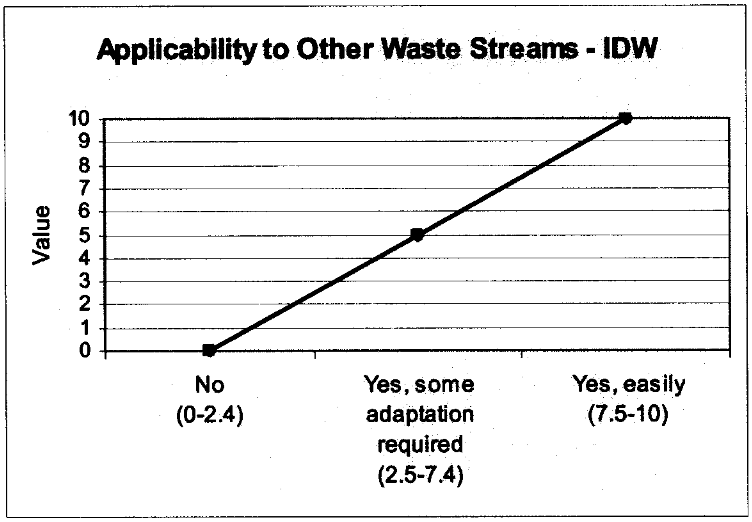


Figure 46. Applicability to other waste streams—investigation-derived waste.

After setting the criteria as outlined in Sections 4.2 through 4.7, the Agencies assigned a weighting factor to each criterion. These are shown in Figures 47 and 48. The first chart (Figure 47) shows how each of the main criteria is weighted (e.g., 33% of the decision is based on implementability of the remedial alternative). Figure 48 illustrates the flow down or distribution of weight across subcriteria that are used to evaluate implementability (e.g., technical feasibility makes up 40% of the implementability criterion) and are broken up further into yet another level of detail. Then, each criterion is evaluated at the greatest level of detail, and the weights are applied at each level to result in an overall evaluation of each remedial alternative. A detailed breakdown of the criteria weights is included in Appendix B.

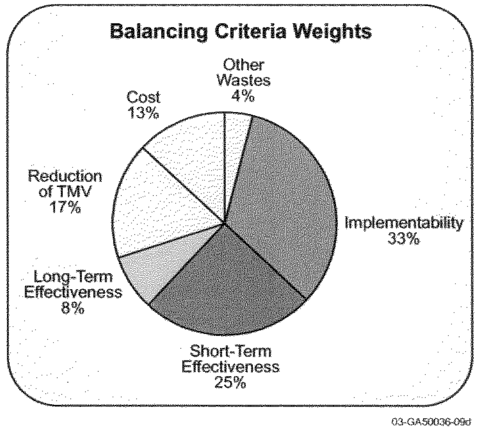


Figure 47. Pie chart for balancing criteria weighting factors.

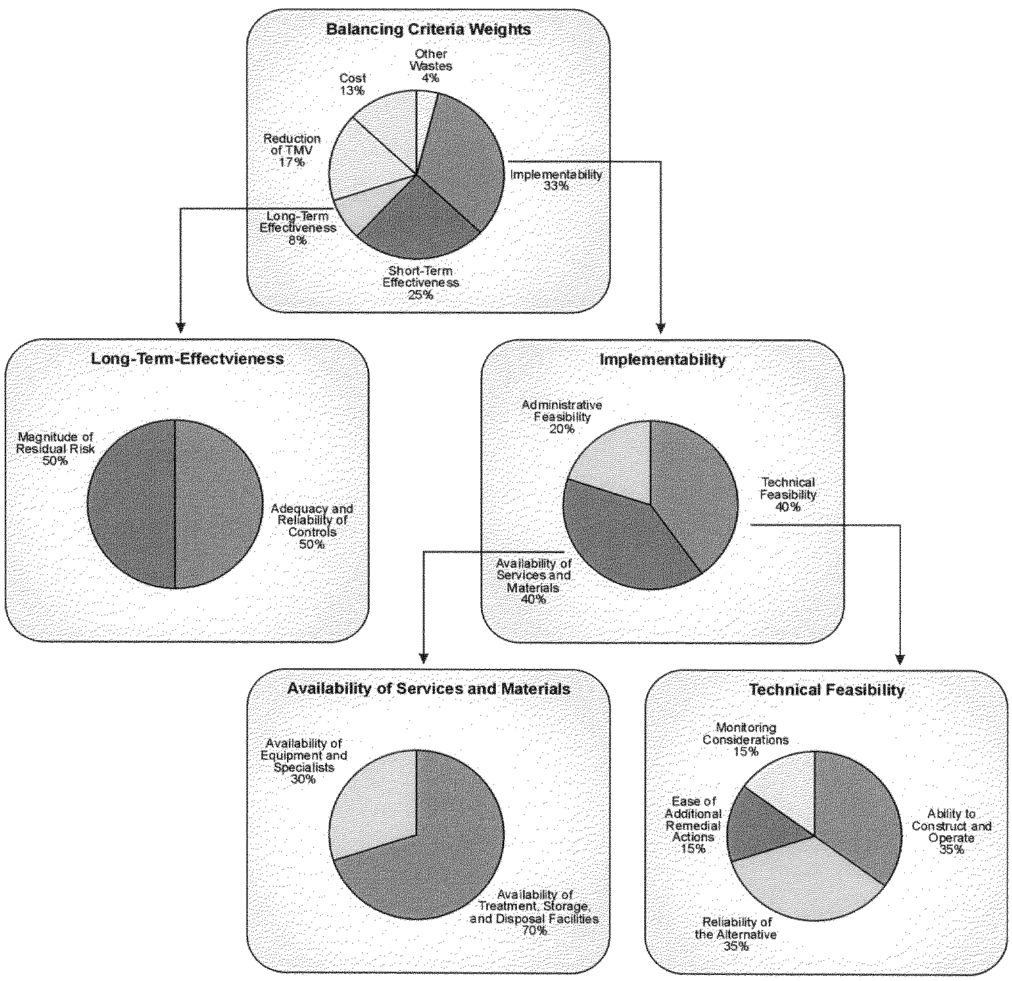


Figure 48. Flow down for criteria weighting factors.

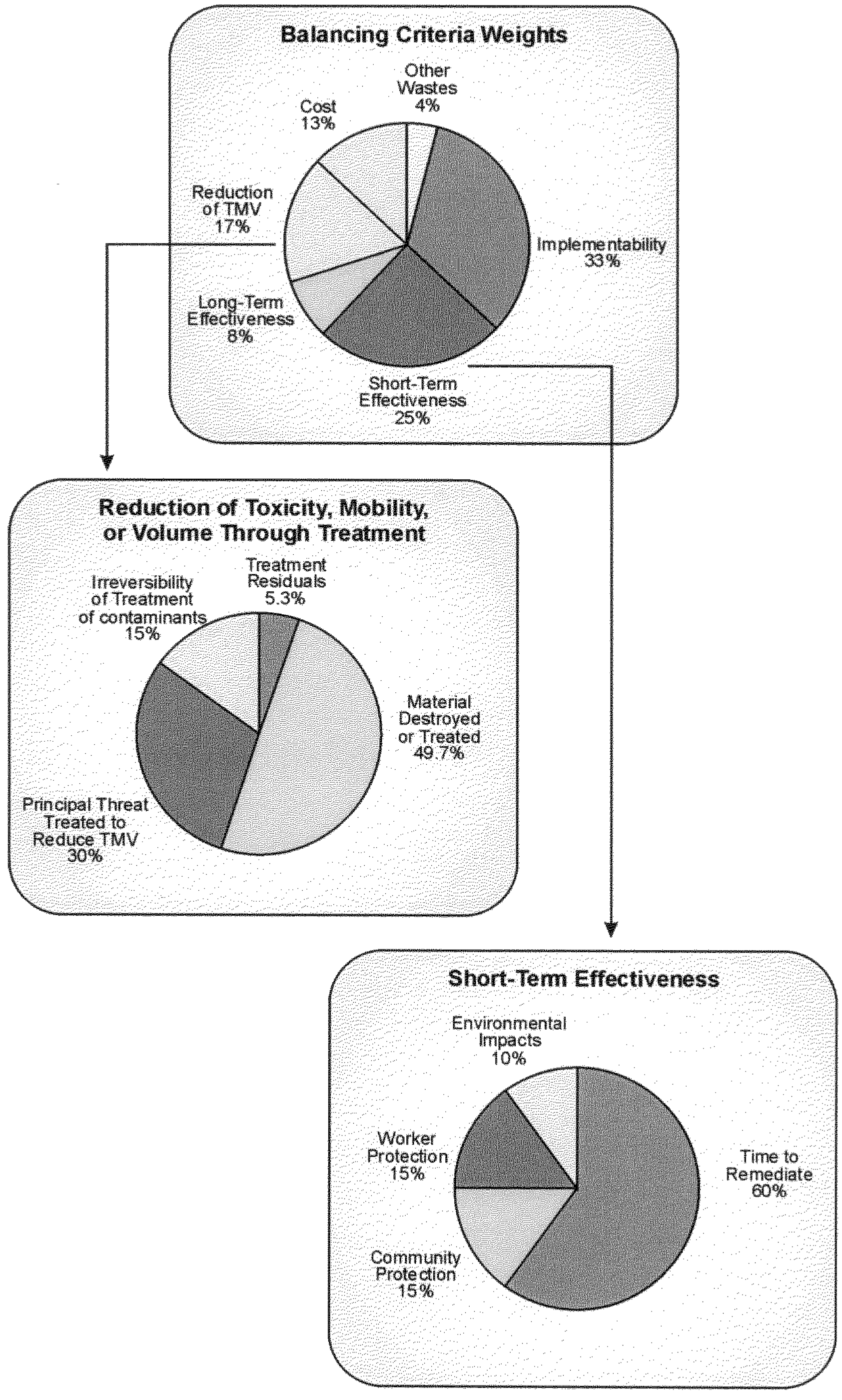


Figure 48. (continued).

The next step in performing the technology evaluation is determining the alternatives' performance against the value functions and then determining the overall score for an alternative by summing the scores for each subcriterion.

5.7 Evaluation Model

As indicated, a previous decision support model was modified to facilitate objective selection of the preferred alternative for the V-Tanks. The model includes quantitative weighting factors and value functions for the various criteria, which were derived from a consensus meeting with the three Agencies on August 26, 2002. The Agencies collectively decided which criteria to include under the CERCLA guidance, how each of the criteria would be weighted, and how the range of values for the criteria would be scored. Details on the weighting factors and the value functions for each of the individual subcriteria are included in Appendix B. A detailed description of the model, including the validation process, is documented in the "V-Tanks Decision Support Model Design Report (Draft)."[c]

5.8 Assessment of Alternatives against Comprehensive Environmental Response, Compensation, and Liability Act Criteria

Table 17 provides a comparative analysis of the seven alternatives against each of the CERCLA criteria outlined above. The table is structured around the criteria, and it includes the value functions (graphs), the input parameter (x-axis) assigned for each alternative, and the associated justification. The numerical value of the input parameter was obtained through consensus by a group of INEEL experts across various disciplines. These input parameters were provided to the V-Tank Decision Support Model (see footnote c) that converted these parameters, through the value functions, to an output value for each alternative and for each criterion. Then, the output values were multiplied by the weighting factors assigned by the Agencies to generate a score. Each of the scores for the criteria was summed to generate a final score for each alternative. The scores are summarized in Section 5. Detailed output from the model is provided in Appendix C.

c. INEEL, 2002b, "V-Tanks Decision Support Model Design Report (Draft)," INEEL/EXT-02-01448, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, November 2002.

Table 17. Comparative assessment of alternatives against each Comprehensive Environmental Response, Compensation, and Liability Act criterion.

Criterion	Alternative Number	Alternative	Input Parameter	Justification
		4.2 Implementability		
4.2.1 Technical Feasibility				
4.2.1.1 Ability to Construct and Operate *(State of the Technology)* Scale: Research: 0–1.9 Development: 2–3.9 Demonstration: 4–5.9 Used in similar applications: 6–7.9 Used routinely: 8–10 This subcriterion focuses on the maturity of the technology.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	7 6 6 6 4–5 3 5	Planar ISV has been used in similar applications at the Los Alamos National Laboratory and the Oak Ridge National Laboratory. In addition, a simulated demonstration was completed at DOE's Hanford Site. Planar ISV operations also have been conducted in Australia and Japan. Therefore, ISV is judged to be used in similar applications. While similar technologies have been used, ESV has not been deployed using portable systems within the DOE complex. Large-scale, stationary vitrification plants have been operated at West Valley, and one is currently operating at the Savannah River Site. Another ESV system is in final design at the Hanford Site. Therefore, ESV is judged between demonstrations and used in similar applications. Similarly, the TD on/off-Site and TD on-Site alternatives use a technology that is currently used in similar applications; however, these are judged equivalent to ESV due to the lack of experience in a radiological environment. The TD off-Site alternative, however, is judged to be in the demonstration phase due to the lack of soil feed to the TD unit and the associated increase of radiological issues. Treatability studies have been completed for CO/S of actual V-Tank waste. The IS-CO/S is in the development phase, since considerable technical uncertainties remain, such as corrosion and the ability to maintain temperature control. Some commercial applications currently exist for ES-CO/S. In addition, there are planned DOE applications at the Oak Ridge National Laboratory and Savannah River Site. Therefore, ES-CO/S is judged to be in the demonstration phase.

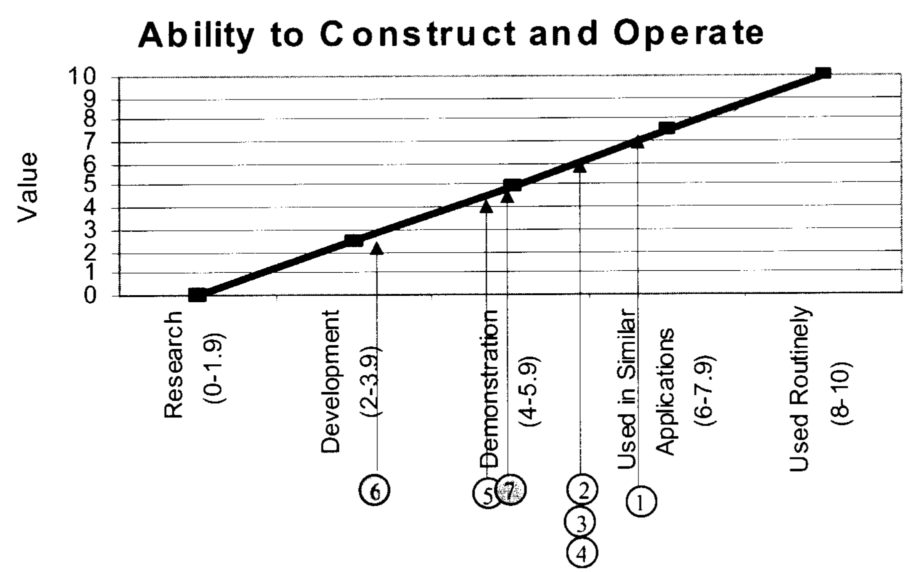
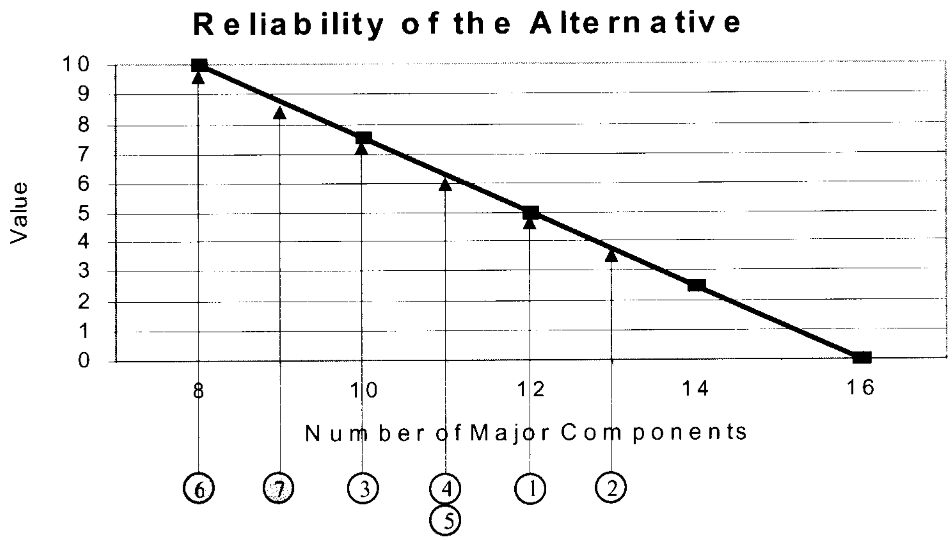


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.2.1.2 Reliability of the Alternative ***(Number of Major Components)*** Scale: 8–16 This subcriterion addresses the likelihood that technical problems associated with implementation will lead to schedule delays.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	12 13 10 11 11 8 9	The input parameter represents the major process components for each alternative. The "major components" generally correspond to those unit operations identified on the process flow diagrams, with certain lesser units combined (e.g., condensers and demisters). Furthermore, the additional shielding required for ex situ operations was credited as an additional component.



Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.2.1.3 Ease of Additional Remedial Action Scale: Abandon technology: 0–2.9 Adjust technology: 3–6.9 Immediate recovery: 7–10 This subcriterion addresses future remedial actions that might need to be undertaken and how difficult it would be to implement such additional actions (i.e., recovery).	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	4 5 6 7 6 7 8	In situ vitrification is clearly the most difficult to recover from noncompliant final waste forms or severe process anomalies, but this shortcoming does not require complete abandonment of the technology. For example, if the glassified waste form does not meet the ICDF's disposal requirements, it must first be cooled and another starter path installed before repeating the vitrification process. Ex situ vitrification is less complicated to recover from process anomalies than ISV, but more complicated than the other technologies. All of the TD and CO/S alternatives have intermediate steps that allow corrective action before generation of the final waste form. However, in the case of TD, this recovery step involves recycling the product to the TD unit, which is a relatively complicated operation. In addition, off-Site shipment issues associated with the TD on/off-Site and TD off-Site alternatives generally are more difficult to prepare for and recover from, particularly if the waste is found noncompliant upon receipt and before treatment or disposal. If the oxidation/reduction process was not completely effective, immediate recovery is possible since the same steps can simply be repeated, but perhaps for a slightly longer duration or at higher temperatures. This recovery also will be easier for ES-CO/S than IS-CO/S, due to improved process control (e.g., temperature). For example, an alternative to insufficient oxidation of TCE is to evaporate it and collect it on the GAC bed. However, this approach would not work for SVOCs, some of which could require a 90% + DRE. Therefore, the CO/S alternatives did not receive maximum scores.

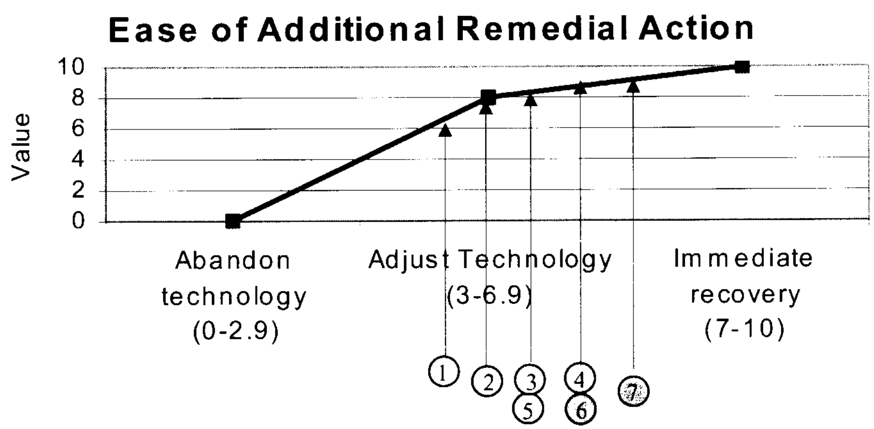
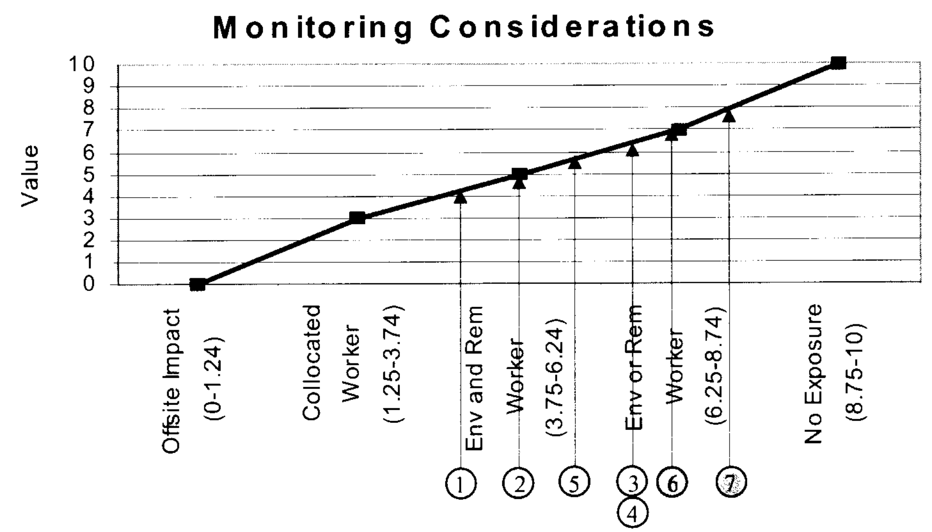


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.2.1.4 Ability to Monitor the Effectiveness of the Remedy Scale: Off-Site impact: 0–1.24 Collocated worker: 1.25–3.74 Environment and remediation worker: 3.75–6.24 Environment or remediation worker: 6.25–8.74 No exposure: 8.75–10 This subcriterion addresses the possible consequences, in terms of exposure to hazards, that a failure to effectively monitor the performance of the remedy could have on people or the environment.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	4 5 7 7 6 7.5 8.5	Without sufficient monitoring, risks directly correlate to the energy input into the system (i.e., the greater the energy input, the higher the risk). When considering accident scenarios, it appears the vitrification alternatives pose a potential for environmental and remediation worker exposure, but no realistic impact to even a collocated worker. Ex situ vitrification has slightly less risk than ISV, due to increased process control. The TD alternatives generate a thermally hot, dusty-type residue, which can be contained, but has the potential for remediation worker exposure during certain material-handling operations. The higher radiation fields associated with TD off-Site constitute higher risk than the other TD alternatives. For IS-CO/S, a potential risk exists to the environment due to uncertainty of tank integrity during the oxidation step (i.e., chloride pitting of stainless steel). Finally, ES-CO/S appears to pose the lowest risk, due to the low temperatures and controlled environment, although risk is not totally eliminated.



Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.2.2 Administrative Feasibility				
Number and Complexity of Required Administrative Process Approvals Administrative Approval Scale: 0–5 Complexity Scale: 0–1, 0.25 increments Note: Input is obtained by adding up the complexities for safety documentation, operational readiness, Hg retort alternative (Hg), PCB destruction alternative (PCB), and off-Site disposal.	 ① ② ③ ④ ⑤ ⑥ ⑦	 *ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	(SD+OR+Hg+PCB+OD=TOTAL) 1 + 0.5 + 0.25 + 0.25 + 0 = 2 0.75 + 0.75 + 0.25 + 0.25 + 0 = 2 0.5 + 0.25 + 0 + 0 + 0 = .75 0.75 + 1 + 0 + 0.25 + 0 = 2 0.5 + .75 + 0 + 0 + 1 = 2.25 0.75 + 0.5 + 0.5 + 0.5 + 0 = 2.25 0.5 + 0.25 + 0.5 + 0.5 + 0 = 1.75	In situ vitrification has historically had significant SD complexity. Its previous applications warrant a moderate OR ranking. In situ vitrification needs alternate treatment standard acceptance and a TSCA risk-based petition for both Hg retort and PCB destruction, respectively. However, both are of minor complexity. The primary waste is disposed of on-Site. For all other alternatives, expect thermal desorption off-Site. Ex situ vitrification has slightly less SD complexity than ISV due to its ex situ nature. However, it is less developed, thereby increasing OR ranking. Like ISV, regulatory approvals are of minor complexity. Thermal desorption on/off-Site has moderate SD complexity and minor OR complexity due to its ex situ nature, smaller number of components, and lack of a TO. It meets Hg retort and PCB destruction requirements. On-Site TD uses a TO to treat the organic contaminants. This raises SD complexity to major and OR complexity to extreme. It meets Hg retort requirements, but requires minor regulatory approvals for PCB destruction using a TO. Off-Site TD is expected to have moderate SD complexity and major OR complexity due to its potential for high-radiation exposures. It meets Hg retort and PCB destruction requirements. It requires off-Site disposal of the treated primary waste stream to facilities currently not accepting this type of waste. This is further complicated by its unknown status as TRU or non-TRU waste. The IS-CO/S has major SD complexity and moderate OR complexity due to its in situ design and operational uncertainties. Regulatory approvals for Hg retort and PCB destruction are more complex, since they differ from approved thermal processes. The primary waste is disposed of on-Site. The ES-CO/S is expected to have moderate SD complexity and minor OR complexity due to its ex situ nature and simpler design and operation. Regulatory approvals for Hg retort and PCB destruction are equivalent to IS-CO/S (moderate).

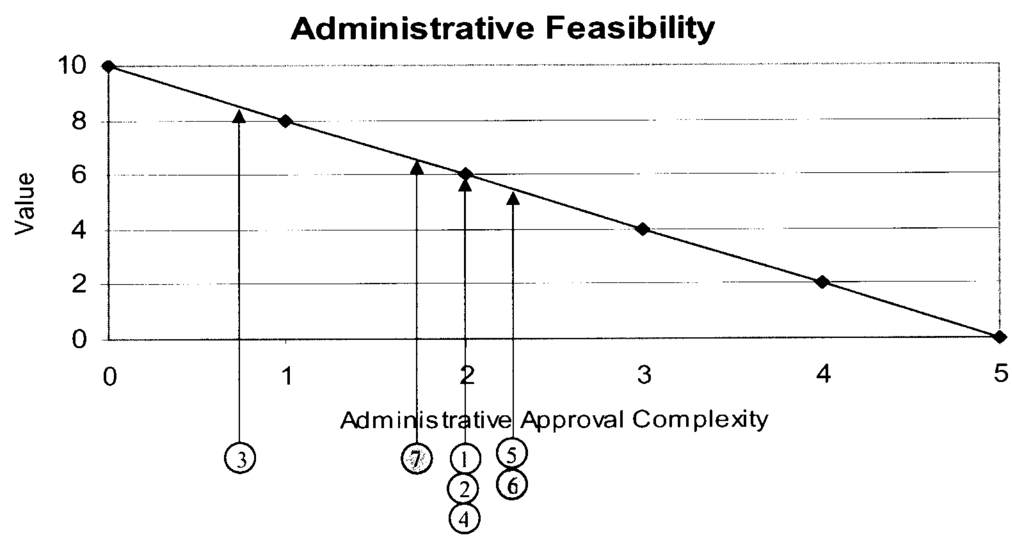
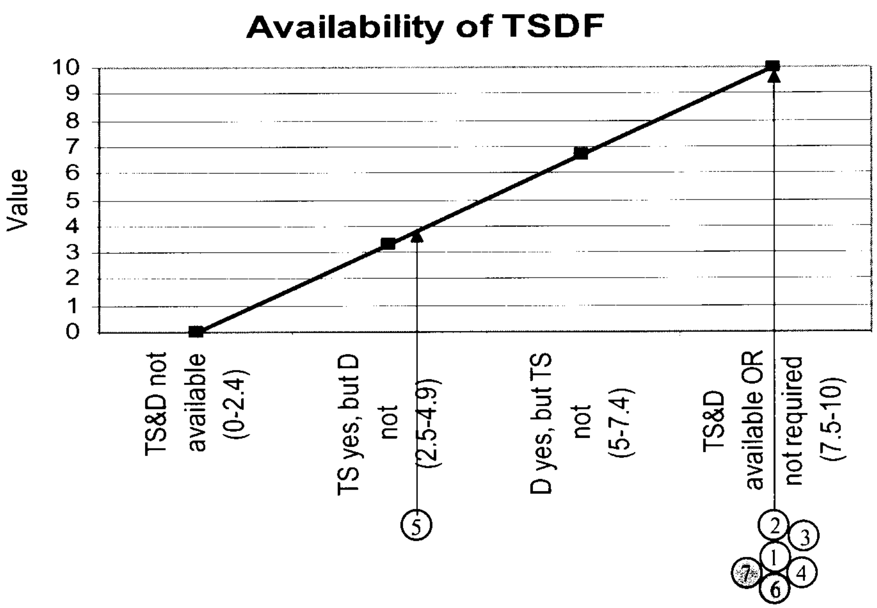


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.2.3 Availability of Services and Materials				
4.2.3.1 Availability of Treatment, Storage, and Disposal Facilities Scale: TS&D not available: 0–2.4 TS available, but D not: 2.5–4.9 D available, but TS not: 5–7.4 TS&D available OR not required: 7.5–10 This subcriterion addresses the availability of services, such as treatment, storage capacity, and disposal.	1	*ISV*	10	All alternatives, with the exception of off-Site TD, have identified TSDFs that can immediately accept the associated waste streams from each process. (This assumes the ICDF is approved for disposal.) Off-Site TD has an identified disposal facility if the waste is classified as TRU waste (>100 nCi/g), but not if the TRU concentration in the waste is between 10–100 nCi/g. This option would require on-Site storage until the off-Site disposal facility is ready to accept the waste. (Note: The WIPP is approved for remote-handled waste, but it does not plan to accept this waste for several years. Furthermore, the V-Tank waste must be approved and added to the authorized inventory. Currently, Nevada and Washington are not accepting out-of-state mixed waste.) Note: Soil disposal was excluded, since all alternatives dispose of the soil to the ICDF.
	2	*ESV*	10	
	3	*TD on/off-Site*	10	
	4	*TD on-Site*	10	
	5	*TD off-Site*	3.75	
	6	*IS-CO/S*	10	
	7	*ES-CO/S*	10	



Criterion	Alternative Number	Alternative	Input Parameter	Justification
INEEL Control Factor (for TSDFs): Scale: Neither TS nor D: 0 3.32 TS or D: 3.33–6.66 TS & D: 6.67–10 This factor addresses whether the INEEL is in control of the TSDF.	1	*ISV*	7.5	The vitrification and CO/S alternatives produce only one waste stream requiring off-Site disposal: the GAC filter. (The ICDF cannot accept GAC filters that do not meet LDRs.) The remaining waste from these four alternatives can be disposed of at the ICDF, including SGAC filters. The TD on/off-Site alternative requires disposal of the off-gas waste products off-Site (condensate and GAC filters), but all other waste can be disposed of on-Site. The TD on-Site alternative can dispose of all its waste at the ICDF. The TD off-Site alternative disposes of the majority of its waste off-Site.
	2	*ESV*	7.5	
	3	*TD on/off-Site*	5	
	4	*TD on-Site*	10	
	5	*TD off-Site*	0	
	6	*IS-CO/S*	7.5	
	7	*ES-CO/S*	7.5	

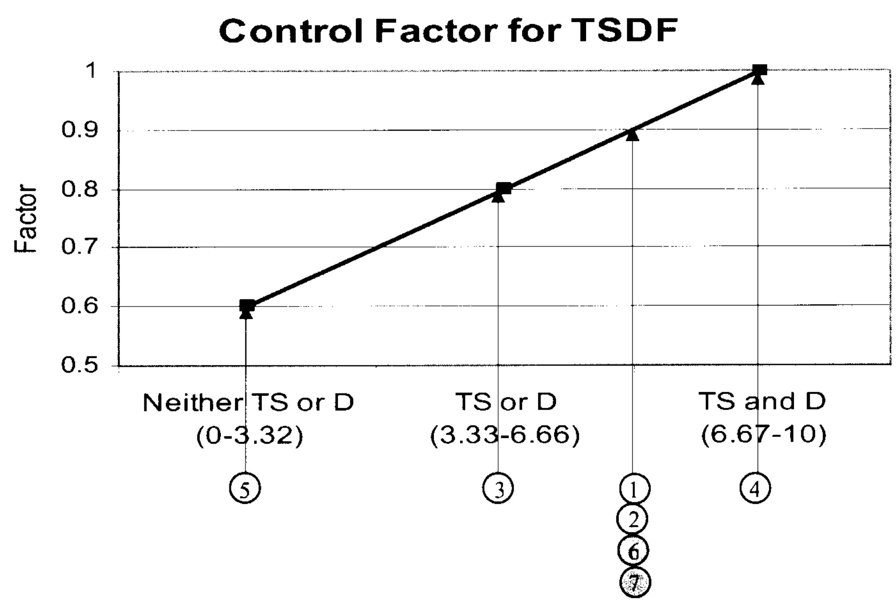
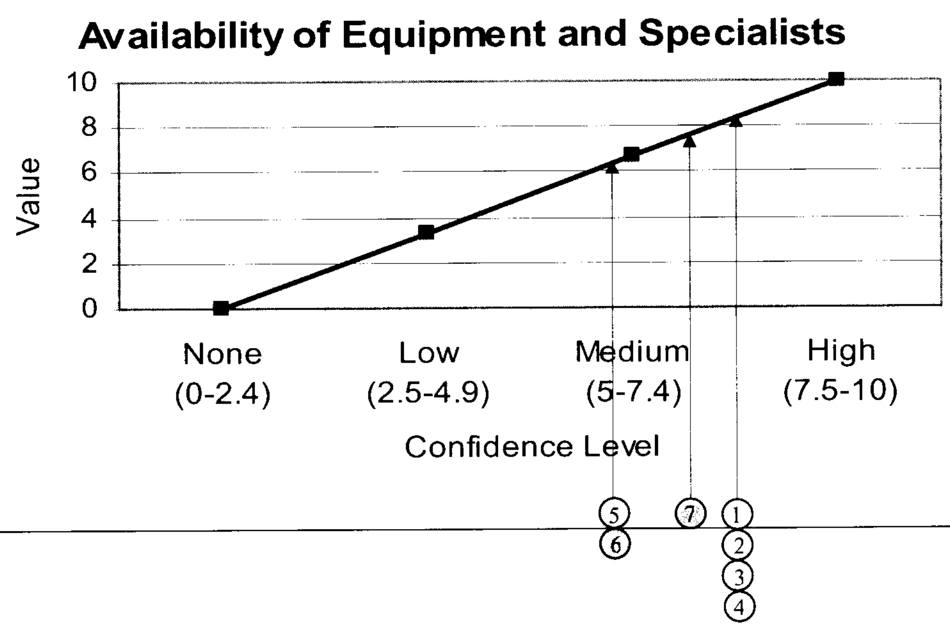


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.2.3.2 Availability of Equipment and Specialists (*Confidence Level*) Scale: None: 0–2.4 Low: 2.5–4.9 Medium: 5–7.4 High: 7.5–10 This subcriterion addresses the availability of equipment and specialists for each alternative.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	7.5 7.5 7.5 7.5 6 6 7	In situ vitrification only has one known vendor with any application/demonstration experience. Ex situ vitrification appears to have at least two viable vendors, but they lack direct experience with portable systems. The DOE complex has considerable experience with vitrification, but generally not with portable-type units, as planned for the V-Tanks. Therefore, a medium–high confidence level is assigned. On/off-Site TD and on-Site TD vendors appear to have significant experience and expertise with operation of TD units in nonradiological environments. In addition, they appear to have identified the necessary expertise to solve associated challenges for operation of these units in the low radiological environment that will exist with these two alternatives, due to the addition of soil to the TD unit. Therefore, a medium–high confidence level is assigned. Off-Site TD produces a waste stream with significantly higher radiation fields than all other alternatives, and it requires operation of the TD unit without soil addition. These factors are judged to reduce confidence in the availability of the necessary expertise to medium. Similarly, IS-CO/S has several technical uncertainties (as discussed earlier) and is judged medium. The ES-CO/S lacks vendors with experience in DOE applications. However, the process is not complicated, provided an adequate oxidant can be found, which appears likely. Furthermore, in the event that insufficient oxidation does occur, the reaction vessel can be used to evaporate VOCs, such as TCE and PCE, and collect these constituents on a GAC filter for disposal. However, if the oxidant is ineffective on certain SVOCs (e.g., BEHP), another oxidant might have to be found. Consequently, the confidence level is judged medium–high.



Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.3 Short-term Effectiveness				
4.3.1 Length of Time to Remediate				
Time to Complete Waste Treatment *(Number of Years)* Scale: 1–4 years This subcriterion addresses the time from approval of the amended ROD until the tank waste is treated and retrieved or is in stable form (in the case of in situ treatments).	① ② ③ ④ ⑤ ⑥ ⑦	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	2 2 2 2 2 2 2	The primary treatment for all alternatives is planned in FY 2005—2 years after the ROD amendment is signed. Similarly, all off-gas residues, whether treated on-Site or off-Site, appear to have identified TSDFs that should facilitate immediate treatment and disposal.

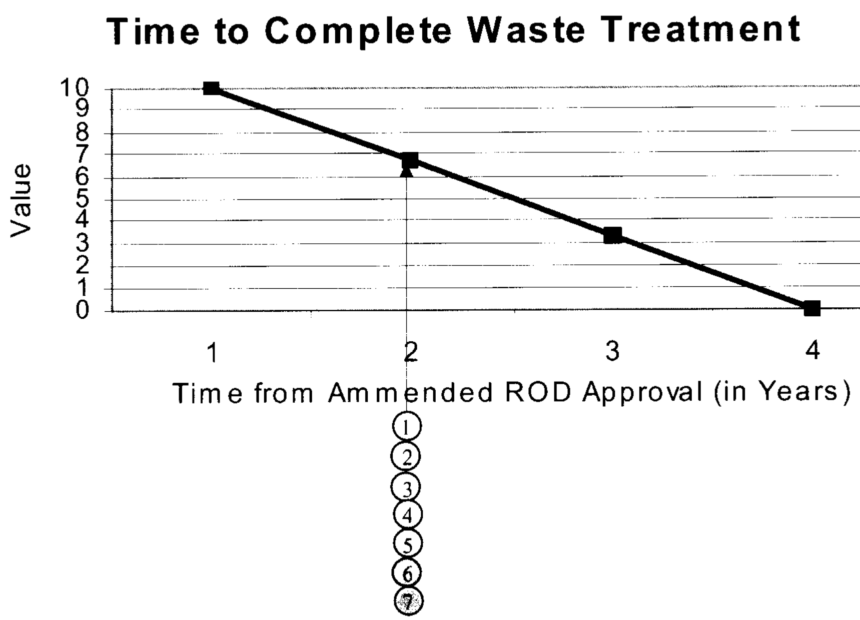
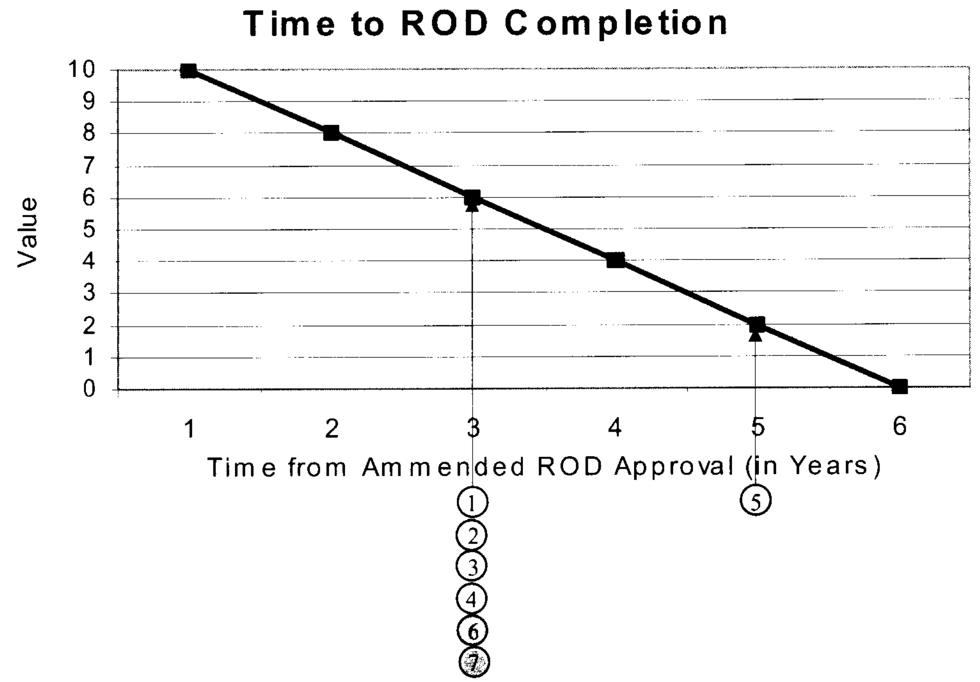


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
Time to ROD Completion *(Number of Years)* Scale: 1–6 years This subcriterion addresses the time to achieve site closure, and it is defined from approval of the amended ROD to when the ROD is fully implemented.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	3 3 3 3 5 3 3	Within 3 years of the ROD amendment, the ROD will be fully implemented (i.e., clean closure and all waste streams disposed of) for all alternatives, except off-Site TD. Off-Site TD has some uncertainty related to disposal of the bottoms' residue to WIPP, NTS, or Hanford. It is assumed on-Site interim storage would be required for 2 years (5 years total).
				
4.3.2 Community Protection				

Criterion	Alternative Number	Alternative	Input Parameter	Justification
Shipments out of INEEL Scale: All untreated waste shipped out: 0-1.9 All treated waste shipped out: 2-3.9 Some untreated waste shipped out: 4–5.9 Some treated waste shipped out: 6-7.9 No waste shipped out: 8–10 This subcriterion satisfies CERCLA's requirement to address protection of the surrounding community during the remedial action.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	8 8 5 10 2 8 8	The vitrification and CO/S alternatives require disposal of their GAC beds off-Site, which, in turn, requires transportation of a solid, untreated waste. The remaining waste is sent to the ICDF. On/off-Site TD and off-Site TD both require transportation of some untreated liquid and solid waste off-Site. Off-Site TD also requires transport of the highly radioactive bottoms' residue off-Site and, therefore, poses the greatest risk. The on-Site TD alternative involves no off-Site shipments. Note: This criterion does not address shipments of material and chemicals to the site before waste shipment and does not consider the soil, since it is assumed to be shipped to the ICDF for all alternatives.

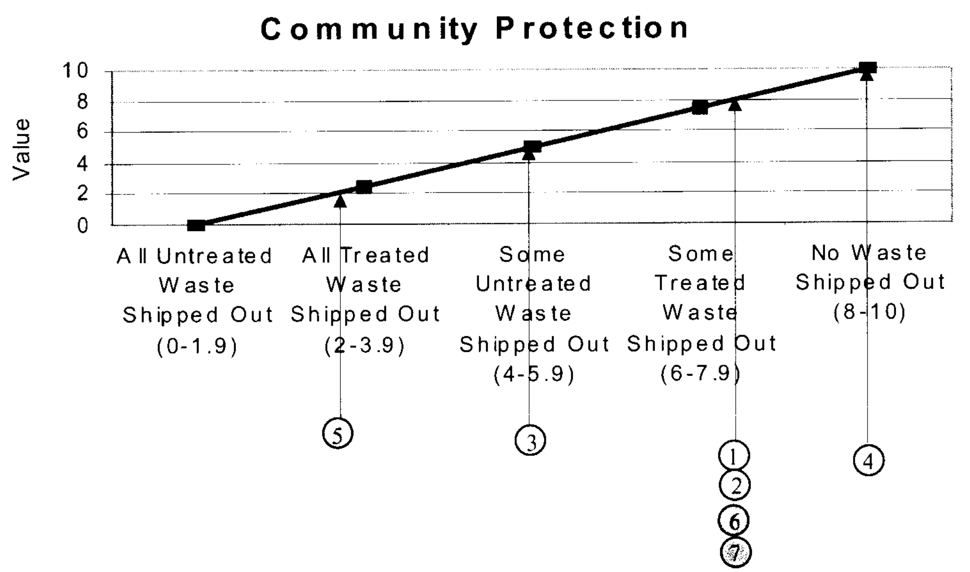
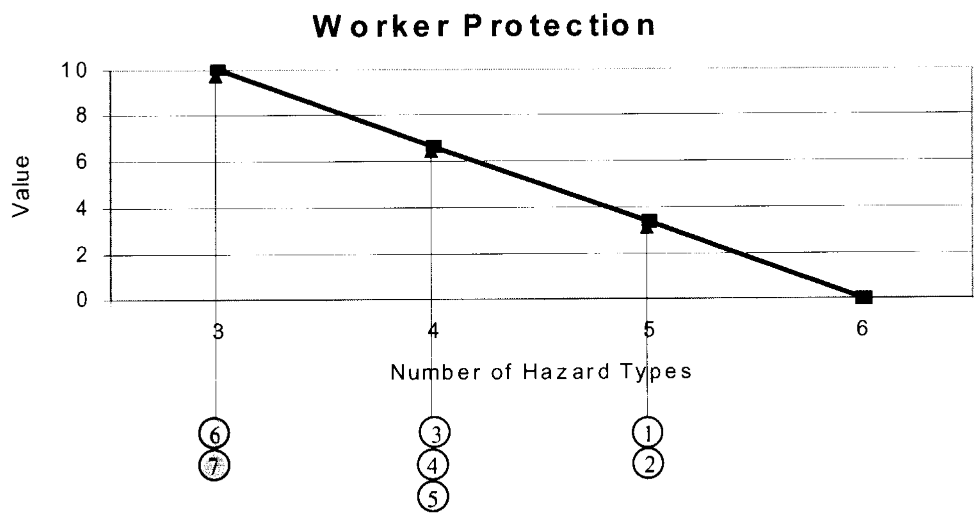


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.3.3 Worker Protection				
Number of Hazard Types	1	*ISV*	5	All alternatives have radiological and industrial hazards (minimum of two hazards).
(1) Confined space entry	2	*ESV*	5	The vitrification alternatives also include the potential for fire/explosions, airborne contaminants, and electrical hazards (total of five).
(2) Radiological hazards	3	*TD on/off-Site*	4	The TD alternatives have fire and airborne contaminant potential (total of four).
(3) Industrial hazards	4	*TD on-Site*	4	The CO/S alternatives introduce hazardous chemicals (total of three).
(4) Potential fire/explosion hazards	5	*TD off-Site*	4	
(5) Hazardous chemicals in process	6	*IS-CO/S*	3	
(6) Airborne contaminants	7	*ES-CO/S*	3	
(7) Electrical hazards				
Scale: 3–6 hazards				
This subcriterion addresses the type of hazards workers might be exposed to during remediation.				



Criterion	Alternative Number	Alternative	Input Parameter	Justification
Complexity to Mitigate Worker Hazard Scale: Low complexity: 0–3.32 Medium complexity: 3.33–6.66 High complexity: 6.67–10 This factor adjusts the number of hazards based on the difficulty of mitigation.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	5 6 7 7 10 3 4	The hazards associated with vitrification have moderate complexity to mitigate, although ISV has less radiological hazard than ESV. The dusty environment created by the TD alternatives is relatively complex to mitigate (moderately high). Off-Site TD is judged highly complex to mitigate due to the higher radiation fields. The CO/S alternatives are judged to have only moderately low complexity for mitigation. The IS-CO/S has lower radiation exposure risk than ES-CO/S.

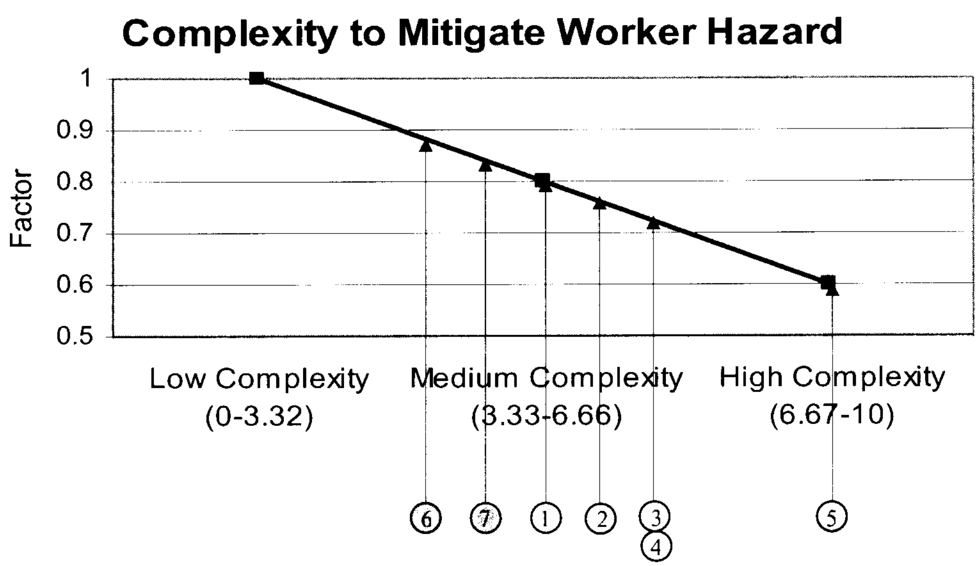
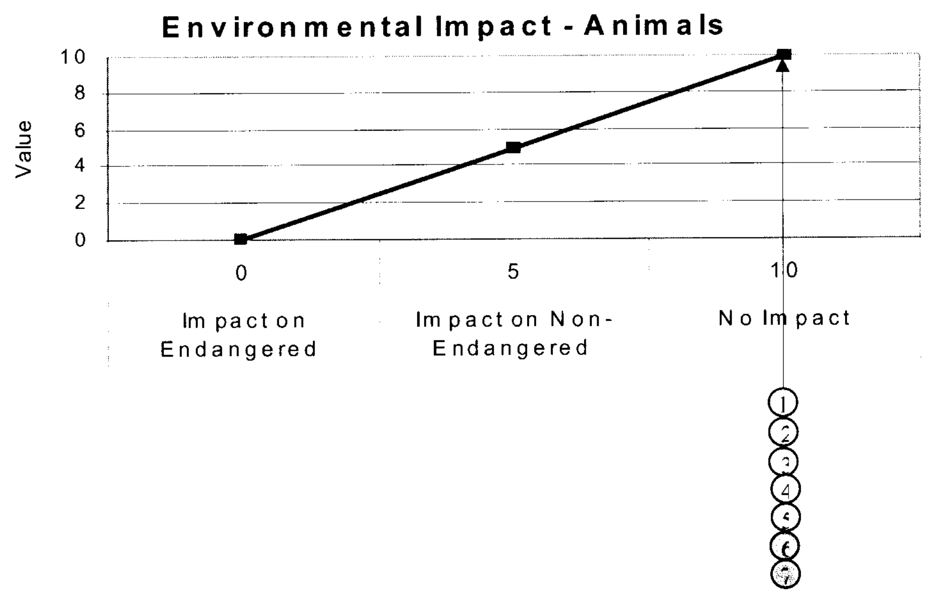


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.3.4 Environmental Impacts				
Animal Impact Scale: Impact on endangered: 0–3.32 Impact of non-endangered: 3.33–6.66 No impact: 6.67–10 This subcriterion addresses the impact on animals—particularly endangered animal species.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	10 10 10 10 10 10 10	No impacts for all alternatives.



Criterion	Alternative Number	Alternative	Input Parameter	Justification
Plant Impact Scale: Impact on endangered: 0–3.32 Impact of non-endangered: 3.33–6.66 No impact: 6.67–10 This subcriterion addresses the impact on plants—particularly endangered plant species.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	10 10 10 10 10 10 10	No impacts for all alternatives.

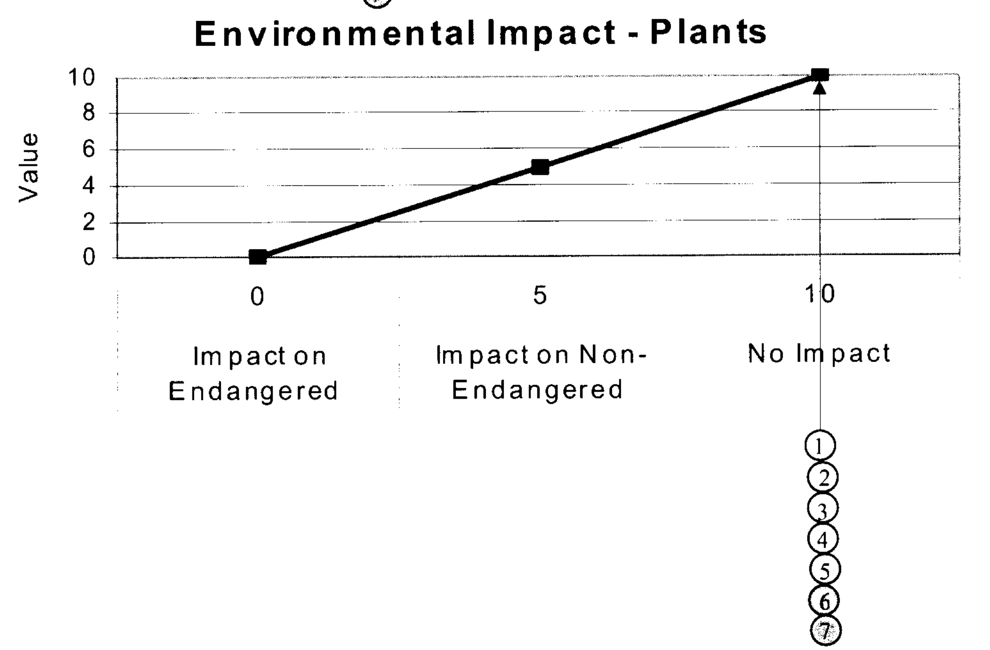
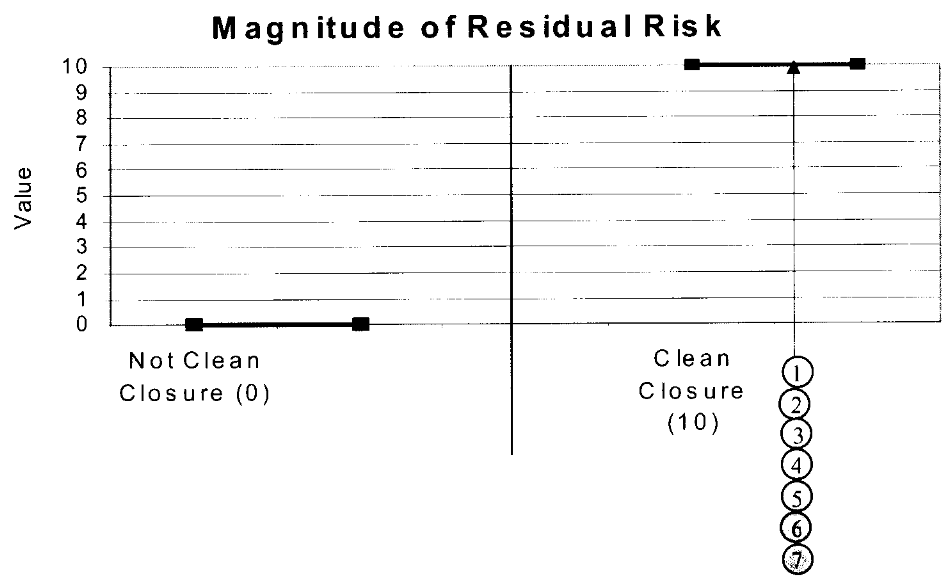


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.4 Long-term Effectiveness and Permanence				
4.4.1 Magnitude of Residual Risk Scale: Not clean closure: 0 Clean closure: 10 This subcriterion assesses the residual risk remaining from untreated waste or treatment residual at the conclusion of remedial activities.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	10 10 10 10 10 10 10	All alternatives achieve clean closure.



Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.4.2 Adequacy and Reliability of Controls Scale: Not clean closure: 0 Clean closure: 10 This subcriterion addresses the adequacy and suitability of controls used to manage treatment residuals or untreated waste that remain at the site.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	10 10 10 10 10 10 10	All alternatives achieve clean closure.

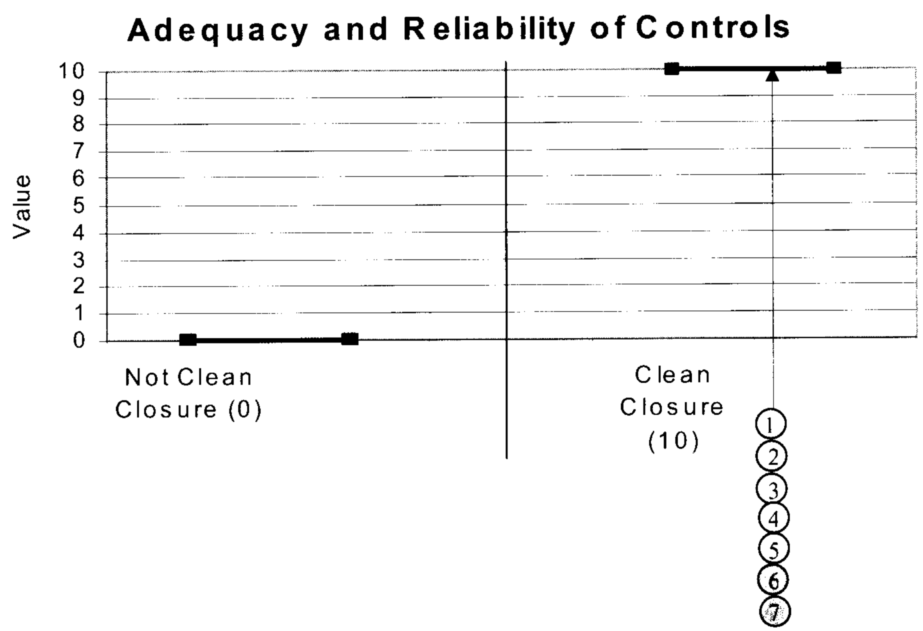
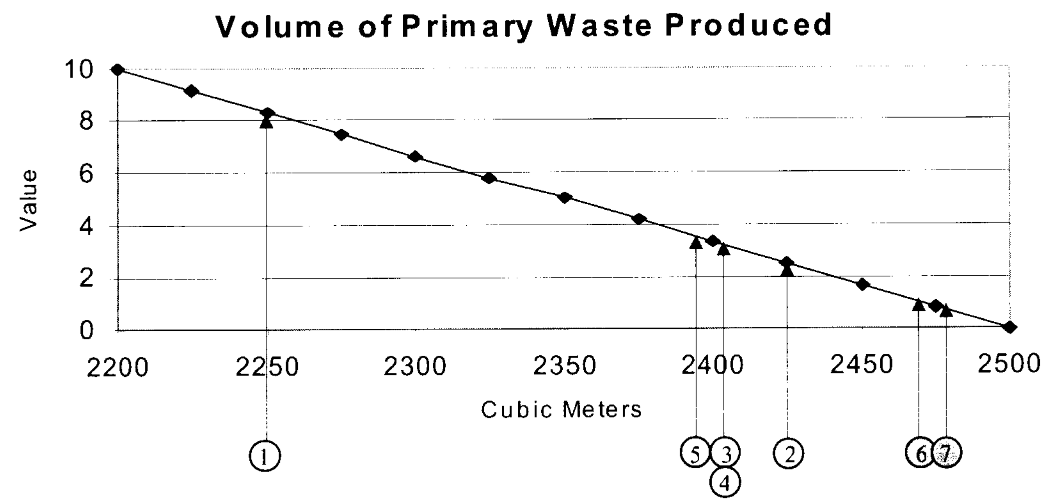


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.5 Reduction of Toxicity, Mobility, and Volume through Treatment				
4.5.1 Amount of Hazardous Material Destroyed or Treated—Note that the quantities used as input parameters for the following criteria are obtained directly from the Pre-Conceptual Design Report (INEEL 2002a). The concentrations given are those in the waste form following all treatments necessary to meet disposal facility requirements.				
Volume of Primary Waste Produced Scale: 2,200–2,500 m^3 This subcriterion addresses the amount of primary waste generated during the remedial action.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	2,250 2,427 2,407 2,407 2,397 2,462 2,469	The volume of primary waste (m^3) includes the soil and tanks, plus the vitrified waste or the TD bottoms' residue, or the grouted waste after chemical oxidation/reduction (as appropriate for each technology).



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Criterion	Alternative Number	Alternative	Input Parameter	Justification
Transuranic Concentration Scale: <10, 10–100, >100 nCi/g This subcriterion addresses the transuranic concentration in the final V-Tank contents' waste form relative to various waste acceptance criteria.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	0.45 6.4 0.82 0.82 70.9 2.2 2.2	All alternatives, except off-Site TD, have primary waste streams whose TRU concentrations are below 10 nCi/g. Calculations indicate that the off-Site TD alternative produces a waste stream with less than 100 nCi/g. Therefore, it is assumed that this material will likely be disposed of at NTS or Hanford. (Disposal at the WIPP is possible if the waste can be mixed with higher TRU content waste, such that the average is >100 nCi/g.)

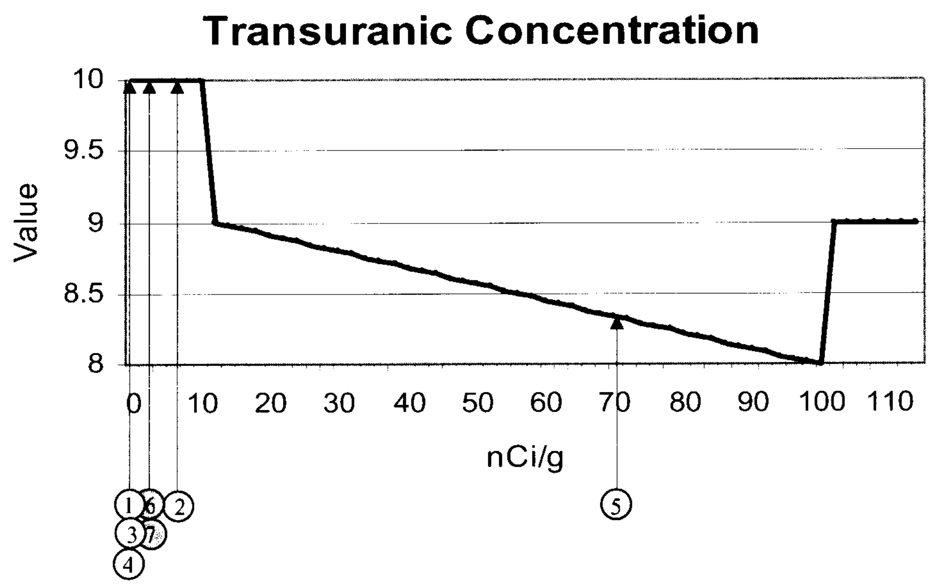
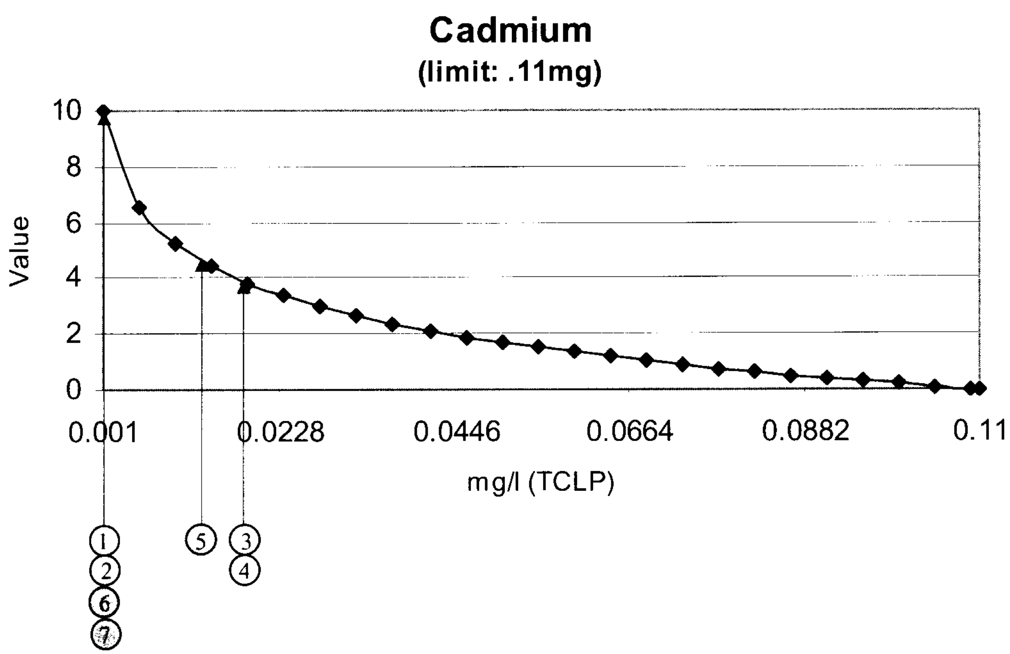


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
Cadmium TCLP Concentration Scale: 0.11–0.0011 mg/L (assumes UTS limits apply) These next six subcriteria address the concentration of certain hazardous constituents in the final waste form relative to the UTSs.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	0 0 0.019 0.019 0.0163 0.00011 0.00011	Essentially, all the cadmium will be volatilized during vitrification; therefore, it will not remain in the primary waste form. The cadmium will not volatize during TD. The TD bottoms' residue does not require stabilization to meet LDRs, except in the case of TD off-Site where soil was not added. The CO/S will stabilize the cadmium. It should be noted that cadmium has been somewhat difficult to stabilize, but the concentrations are low enough that any leachability issues should be avoided. Note: To estimate TCLP concentration for cadmium, lead and mercury, the following leachability ratios (total constituent concentration divided by TCLP concentration—based on extrapolated data) were used for all metals: soil = 100; grout = 10,000; Glass = 1,000,000.



Criterion	Alternative Number	Alternative	Input Parameter	Justification
Lead TCLP Concentration Scale: 0.75–0.0075 (assumes UTS limits apply)	① ② ③ ④ ⑤ ⑥ ⑦	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	0.000014 0.00021 0.26 0.26 0.23 0.0016 0.0016	Lead will be captured in the glassified waste form during vitrification. The TD bottoms' residue does not require stabilization to meet LDRs, except in the case of TD off-Site. The CO/S will stabilize the lead.

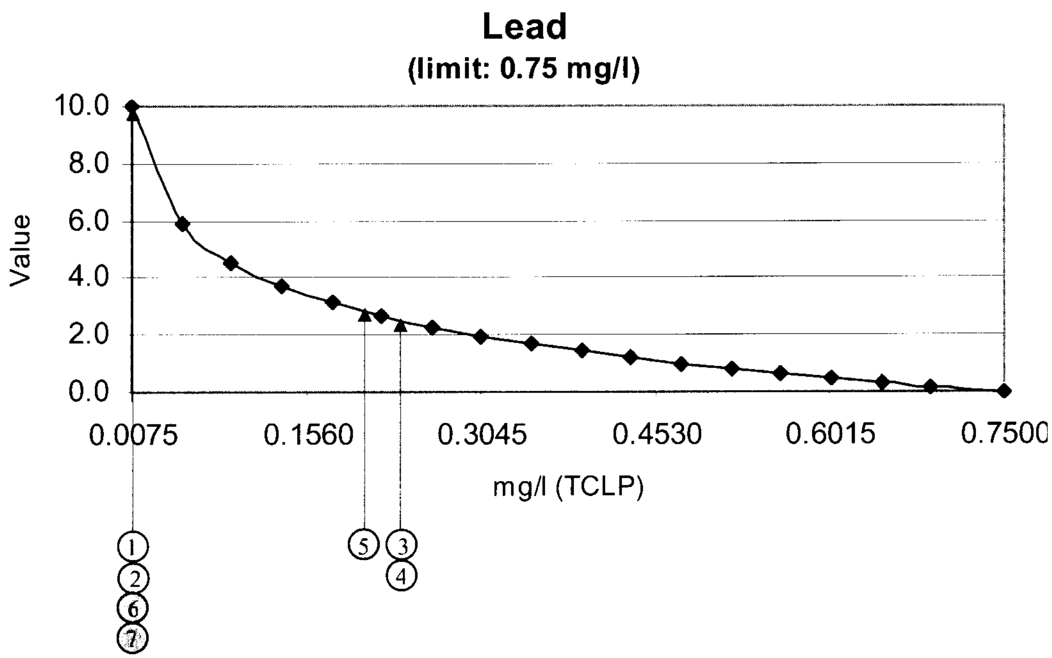
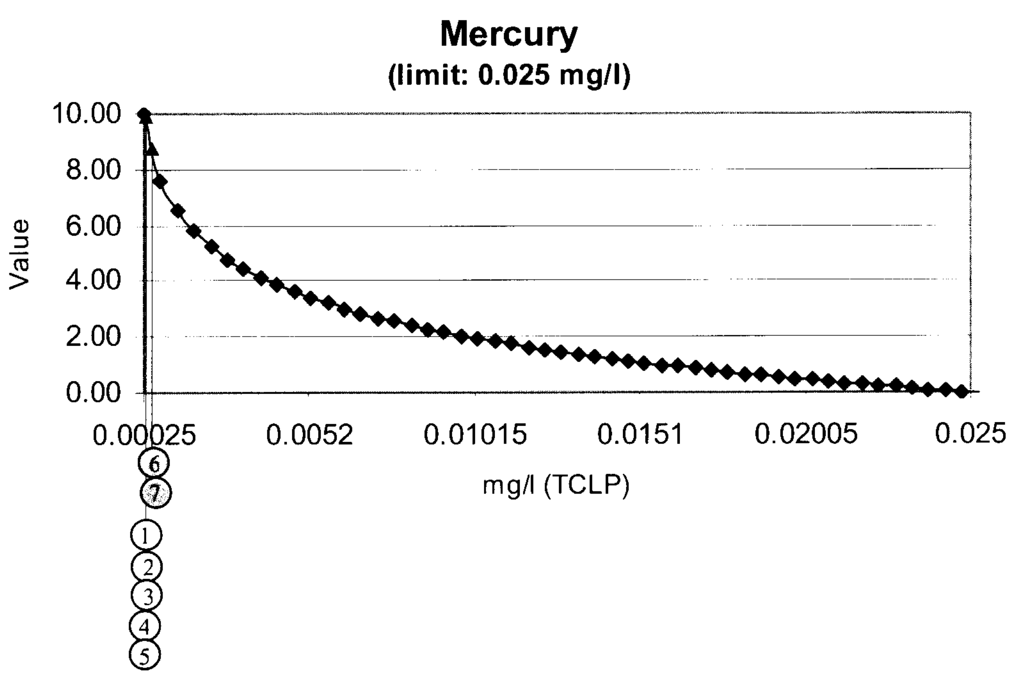


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
Mercury TCLP Concentration Scale: 0.025–0.00025 mg/L (assumes UTS limits apply)	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	0 0 0.00019 0.00019 0.00017 0.0013 0.0013	Vitrification and TD "retort" the mercury, thereby effectively removing it from the primary waste form. The CO/S will stabilize the mercury, probably using a sulfur-containing grout.



Criterion	Alternative Number	Alternative	Input Parameter	Justification
TCE Concentration Scale: 6–0.06 ppm (LDR for F001)	1	*ISV*	0	The vitrification and TD alternatives will effectively destroy or remove all the TCE from the primary waste stream. The CO/S will destroy or remove the TCE concentration below LDRs, but some residuals will remain. Because of the high concentration of TCE in Tank V-9, this could be the most difficult constituent for CO/S to remove, even though it is relatively easy to destroy compared to PCBs and some other SVOCs (e.g., BEHP). Furthermore, as noted earlier, CO/S can evaporate VOCs and collect them on a GAC bed in the unlikely event the oxidation/reduction step is not completely effective. Although not reflected in the mass balances, achieving sufficiently low concentrations will be more difficult for IS-CO/S than ES-CO/S, since more aggressive conditions (e.g., higher temperatures) can be applied more easily ex situ than in situ due to uncertainties with V-Tank integrity under these conditions. Note that TCE limits are based on total concentrations, not TCLP.
	2	*ESV*	0	
	3	*TD on/off-Site*	0	
	4	*TD on-Site*	0	
	5	*TD off-Site*	0	
	6	*IS-CO/S*	0.7	
	7	*ES-CO/S*	0.7	

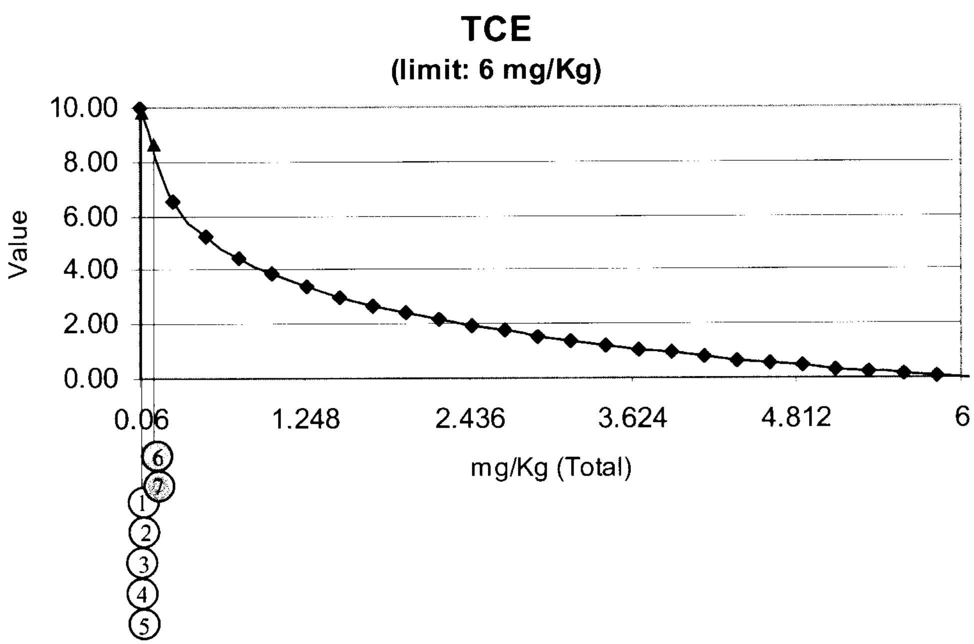
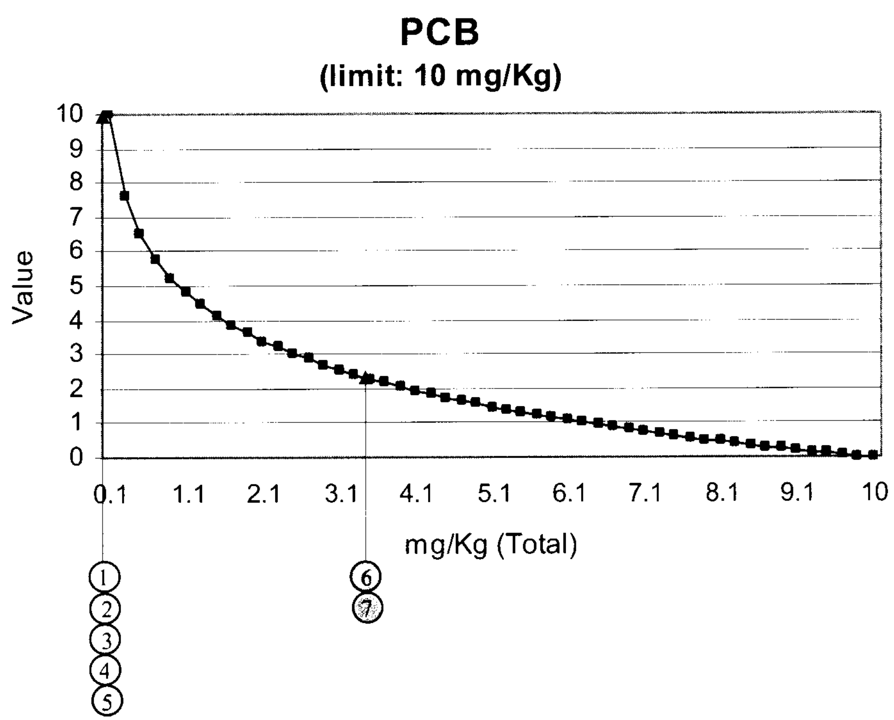


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
PCB Concentration Scale: 0.1–10 ppm (assumes UTS limits apply)	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	0 0 0.0034 0.0034 0.000031 3.3 3.3	The vitrification and TD alternatives will effectively destroy or remove the PCBs from the primary waste stream. The CO/S will destroy PCBs to below LDRs, but some residuals will remain. Note that PCB limits are based on total concentrations, not TCLP.



Criterion	Alternative Number	Alternative	Input Parameter	Justification
BEHP Concentration Scale: 0.28–28 ppm (assumes UTS limits apply)	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	0 0 0 0 0 20 20	The vitrification and TD alternatives will effectively destroy or remove BEHP from the primary waste stream. The CO/S will destroy BEHP to below LDRs, but some residuals will remain. Note that BEHP limits are based on total concentration, not TCLP.

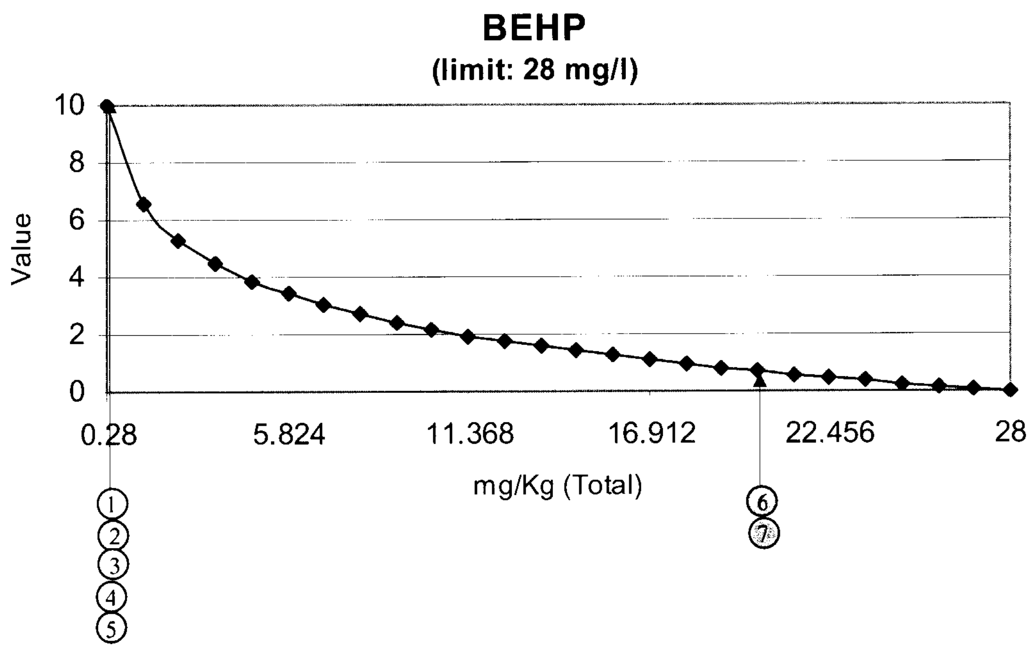
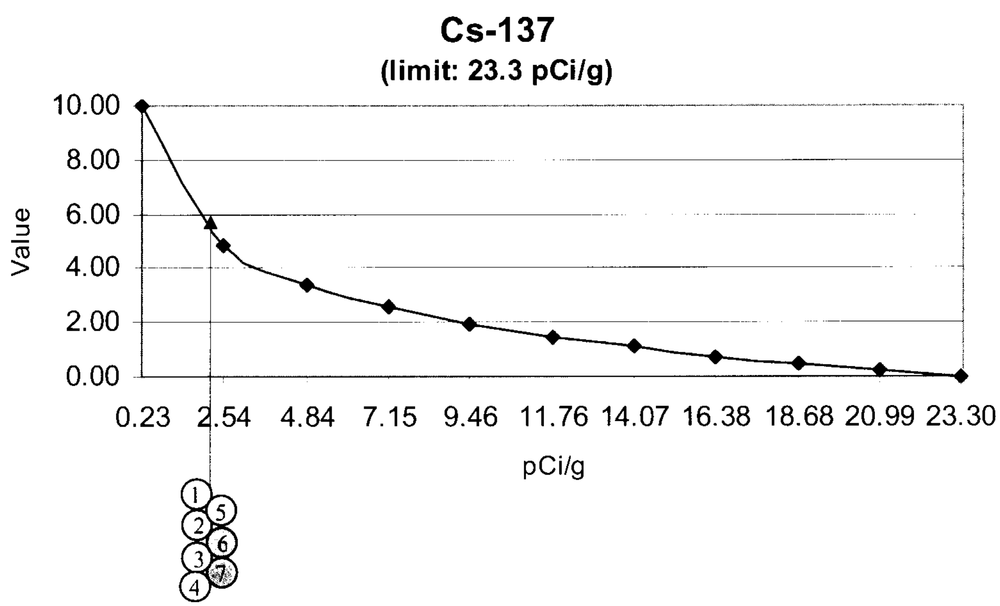


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.5.2 Amount of Principal Threat Treated to Reduce Toxicity, Mobility, or Volume				
Principal Threat Cs-137 Scale: 0.233–23.3 pCi/g This subcriterion applies only to the residual Cs-137 remaining in the soil following remediation.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	2.33 2.33 2.33 2.33 2.33 2.33 2.33	All alternatives accomplish clean closure. It is assumed that soil will be removed from the V-Tank area of contamination until the cesium concentration in the remaining soil is reduced to 2.33 pCi/g.



Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.5.3 Irreversibility of Treatment of Contaminants				
Irreversibility Scale: 0–10,000 years No change in mobility: 0–2.4 Mobility reverses in <100 years: 2.5–4.9 Mobility reverses in <1,000 years: 5–7.4 Mobility reverses in <10,000 years: 7.5–10 This subcriterion addresses integrity of the final primary waste form as disposed.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	>10,000 >10,000 1,000 1,000 2,000 2,000 2,000	Vitrified glass is nonreversible for at least 10,000 years based on testing completed to date. Furthermore, a number of the CFTs are removed from the primary waste stream during vitrification, as described previously. Similar to vitrification, several CFTs (e.g., mercury, PCBs, and TCE) are removed during TD. Calculations on the TD bottoms' residue with soil (TD on/off-Site and TD on-Site alternatives) indicate that any remaining CFTs will be below LDR limits without subsequent stabilization. Therefore, the design life of the ICDF (1,000 years) is used as the duration for this criterion. In the case of TD off-Site, the residue will be stabilized and disposed of in a location with at least a 1,000-year design life. Therefore, since typical grouts are stable for at least 1,000 years, the overall duration for irreversibility is expected to be 2,000 years. For CO/S, the organics are removed before disposal. The metals and radionuclides will be stabilized. Because of the low concentration of these constituents, stabilization is actually done primarily as a means to solidify the waste rather than to render it nonleachable. However, the grouted waste form is not as stable as the glass and is generally estimated to prevent mobility for at least 1,000 years, and it is disposed of at the ICDF, which has a 1,000-year design life (i.e., 2,000 years total).

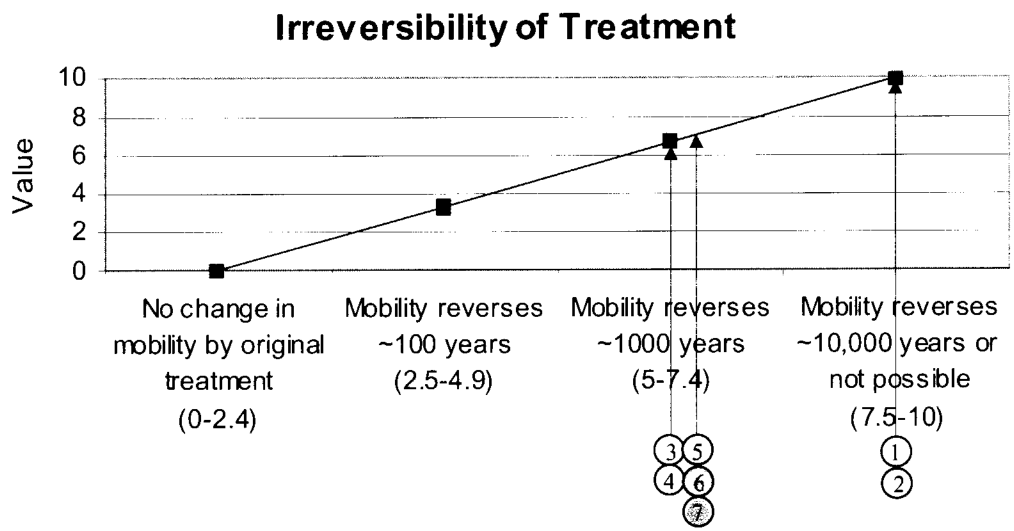
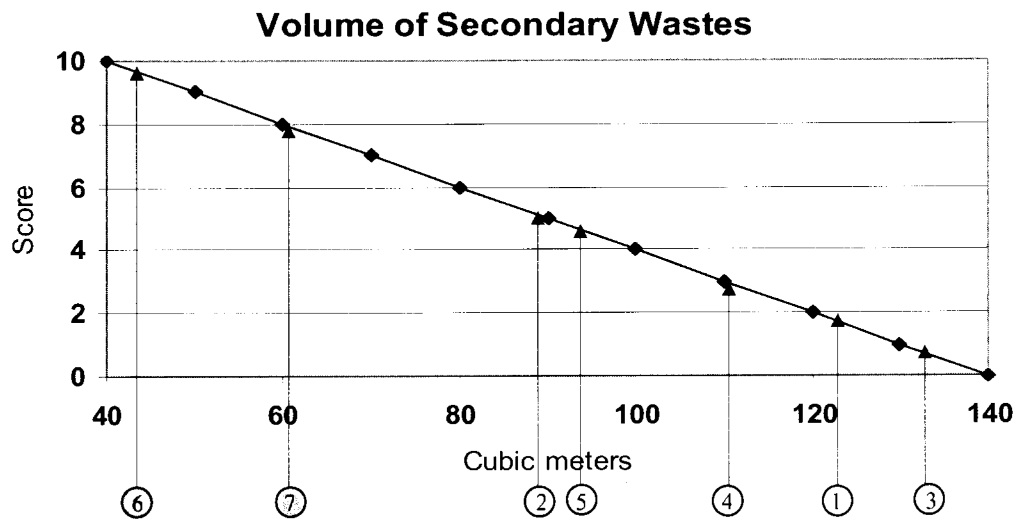


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.5.4 Amount of Treatment Residuals Remaining after Treatment				
Secondary Waste Volume Scale: 40–140 m^3 This subcriterion addresses the total volume of secondary waste generated during the remedial action.	① ② ③ ④ ⑤ ⑥ ⑦	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	123 88 133 110 93 44 60	Secondary waste includes all the off-gas residuals and process equipment that comes in contact with the waste streams. Minimal credit was allowed for possible size reduction on certain equipment/components.



Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.6 Cost				
Life-Cycle Cost (***Net Present Value***) Scale: \$22.1–\$38.9M—range based on estimates at -25/+15% This subcriterion addresses the total life cycle for the V-Tanks' remedial action. Cost is reported as net present value.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	33.0 32.7 30.3 30.3 33.8 29.5 29.4	These numbers are supported by alternative, specific cost estimates (see Appendix A). These life-cycle estimates are at a preconceptual level of detail and accuracy (+50/-30%). Included are historical costs, since the initial ROD remedy was established, and all currently planned future costs. This includes outyear costs associated with institutional controls (i.e., operation and maintenance costs). The cost values have then been reported in terms of net present value, minus escalation costs.

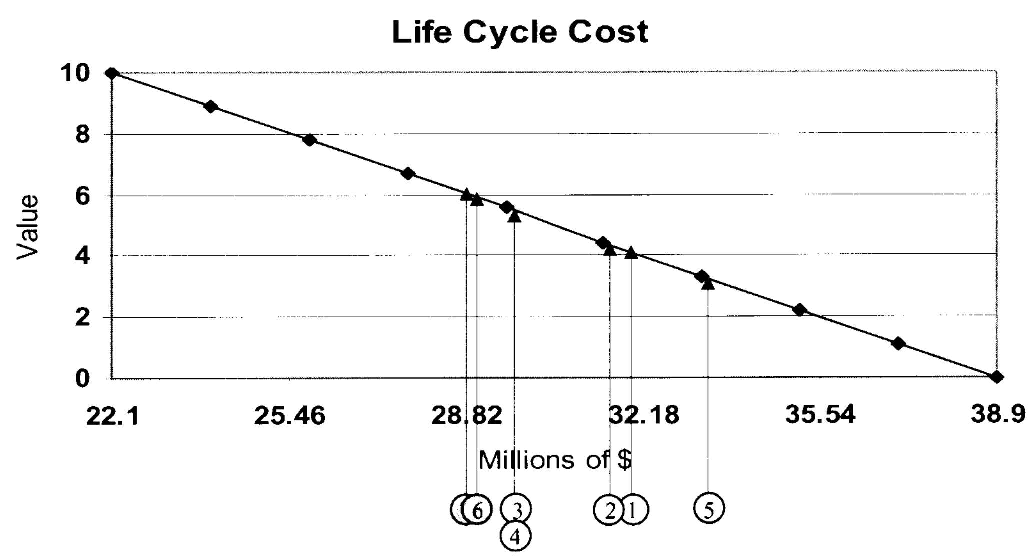
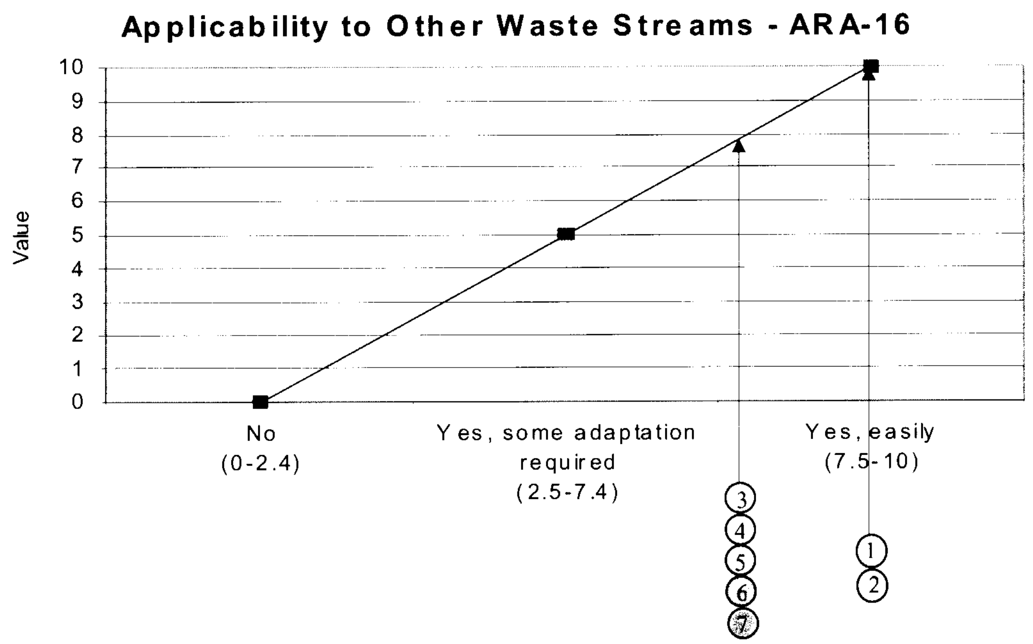


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
4.7 Applicability to Other INEEL CERCLA Waste Streams				
Applicability to ARA-16 Waste Scale: Not applicable: 0–2.4 Some adaptation required: 2.5–7.4 Easily adapted: 7.5–10 These next three subcriteria address the ability of the treatment alternative to satisfactorily treat other comparable INEEL CERCLA waste streams.	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	10 10 8 8 8 8 8	All options are easily adapted to treat ARA-16 tank waste. This waste is contained in a sludge high-integrity container and will require removal prior to treatment by all alternatives, except vitrification, where it may be possible to place the entire high-integrity container into the V-Tank or roll-off container before vitrification. The sludge-like material is comparable to the V-Tank sludge. It does not have significant amounts of mercury, but contains some of the same CFTs.



Criterion	Alternative Number	Alternative	Input Parameter	Justification
Applicability to PM-2A Waste Scale: Not applicable: 0–2.4 Some adaptation required: 2.5–7.4 Easily adapted: 7.5–10	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	10 10 10 10 10 7 7	Vitrification and TD are easily adapted to treat the PM-2A tank waste, since it is solidified waste and can simply be used in place of or in addition to soil. The CO/S could be adapted but, due to the addition of diatomaceous earth, mixing would become more complicated. Note: PM-2A tank waste consists essentially of V-Tank sludge mixed with diatomaceous earth.

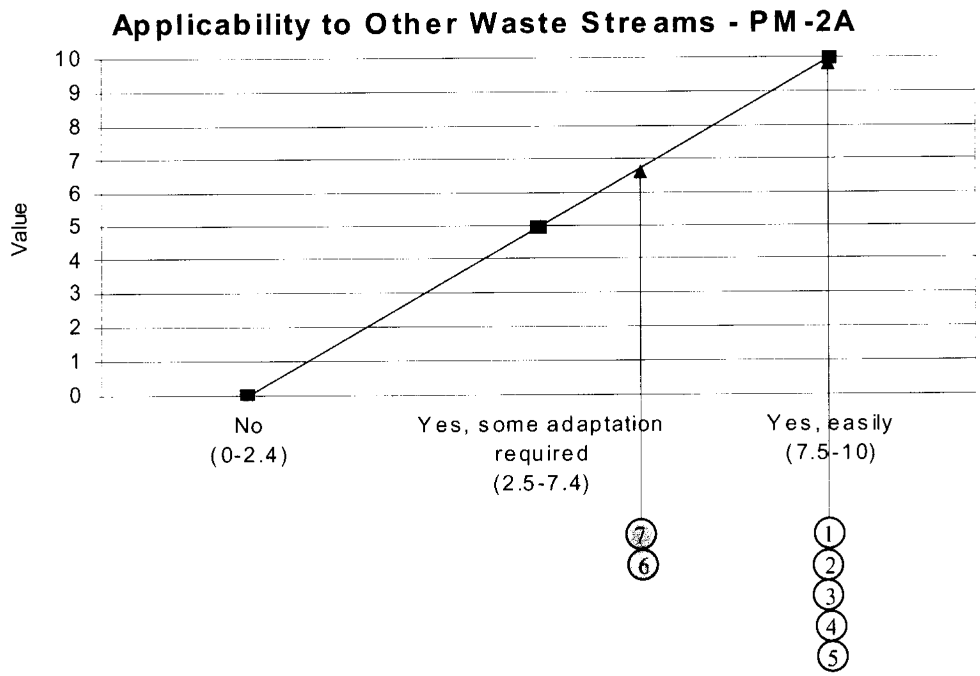
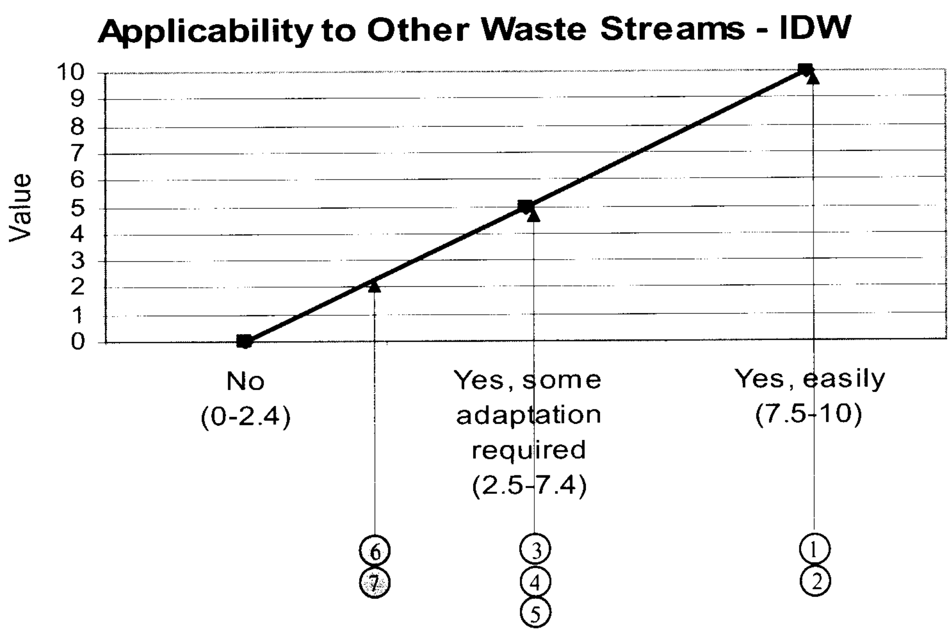


Table 17. (continued).

Criterion	Alternative Number	Alternative	Input Parameter	Justification
Applicability to Investigation-Derived Waste Scale: Not applicable: 0–2.4 Some adaptation required: 2.5–7.4 Easily adapted: 7.5–10	1 2 3 4 5 6 7	*ISV* *ESV* *TD on/off-Site* *TD on-Site* *TD off-Site* *IS-CO/S* *ES-CO/S*	10 10 5 5 5 2 2	Investigation-derived waste includes items such as used equipment, glass, PPE, and sample residue. Vitrification is judged to easily handle these materials. Thermal desorption can handle much of it, but not some of the equipment or glass. The CO/S would have a difficult time with much of the waste, except for the sample residue.



Criterion	Alternative Number	Alternative	Input Parameter	Justification

ARA = Auxiliary Reactor Area
BEHP = bis(2-ethylhexyl)phthalate
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFT = contaminant for treatment
CO/S = chemical oxidation/reduction with stabilization
DOE = U.S. Department of Energy
DRE = destruction and removal efficiency
ES-CO/S = ex situ chemical oxidation/reduction followed by stabilization
ESV = ex situ vitrification
FY = fiscal year
GAC = granular-activated carbon
ICDF = INEEL CERCLA Disposal Facility
INEEL = Idaho National Engineering and Environmental Laboratory
IS-CO/S = in situ chemical oxidation/reduction followed by stabilization
ISV = in situ vitrification
LDR = land disposal restriction
NTS = Nevada Test Site
OR = operational readiness
PCB = polychlorinated biphenyl
PCE = tetrachloroethylene
PPE = personal protective equipment
ROD = Record of Decision
SD = safety documentation
SGAC = sulfur-impregnated granular-activated carbon
SVOC = semivolatile organic compound
TD = thermal desorption
TCE = trichloroethylene
TO = thermal oxidizer
TRU = transuranic
TS&D = treatment, storage, and disposal
TSCA = Toxic Substances Control Act
TSDF = Treatment, Storage, and Disposal Facility
UTS = universal treatment standard
VOC = volatile organic compound
WIPP = Waste Isolation Pilot Plant

6. SELECTION OF PREFERRED ALTERNATIVE

6.1 Identification of Preferred Alternative

Ex situ chemical oxidation/reduction with stabilization is the preferred alternative for treatment of the V-Tank contents. This recommendation is consistent with the outcome of the decision support model as well as follow-on analysis and discussion with the Agencies.

The results of the decision support model are provided in Table 18 and are summarized at the major criteria level. (Appendix C contains a detailed output of the model for each of the subcriteria.) Figure 49 shows a relative comparison of the various alternatives compared to the mean score for all seven alternatives. As illustrated, ES-CO/S received the highest score of the seven alternatives. However, five of the six other alternatives scored only slightly lower (within 5%). This reflects an excellent choice for the selected alternatives and resulted in the need for additional sensitivity analyses, evaluations, and discussions.

Sensitivity analyses and a pair-wise comparison were performed, at the Agencies' request (during the October 22–23 meeting), to evaluate how the predetermined criteria and weighting factors affected the recommended outcome. As an example, one of the sensitivity analyses evaluated potential off-Site disposal of all waste for all the alternatives. This effectively reduced the score of all the alternatives to a level comparable with Alternative 2.c—TD off-Site, which received the lowest overall score. Results of the sensitivity analysis indicated that changes to the weighting factors could alter the relative rankings of six of the seven alternatives, but that the observed change in "technology value" was not significant enough to support a change in the recommended technology or the preestablished weighting factors. Furthermore, some of the input data from the preconceptual designs did not provide the discrimination between alternatives anticipated at the time the weighting was established. For example, criteria such as long-term effectiveness and time to remediate were evaluated the same for all alternatives. However, rather than eliminate these criteria and assign their weighting to another criterion, it was decided to retain the preestablished values.

Key criteria that tended to distinguish between alternatives, such as administrative feasibility, were evaluated further with the Agencies. After additional investigation and discussion, the regulatory approvals necessary to ensure that ES-CO/S remains a viable alternative were clearly delineated. Specific ARARs for the alternative treatments and risk-based disposal were identified that will require Agency approval; these ARARs are listed in detail in Section 5.2.

Another pivotal criterion is the *ability to operate.* Although the process equipment for ES-CO/S is relatively simple, there are limited data about the DREs of various oxidants under comparable conditions. However, a treatability study conducted in 1998 on actual V-Tank waste (INEEL 1998) demonstrated over 99.4% DRE of TCE and 85.2% DRE of PCBs. Since these tests were performed without heating, and the observed DREs have been shown to be sufficient to achieve the LDRs, the technology appears viable. Nevertheless, additional testing will be conducted during the conceptual design phase to confirm the results of the previous study.

Table 18. Summary scoring results for V-Tank remediation alternatives.

	Impl.	Short-Term Effect	Long-Term Effect	Reduction of TMV	Cost	Other Waste Streams	Alternative Score
Alt 1.a (ISV)	6.93	6.33	10	7.79	4.05	9.99	**6.94**
Alt 1.b (ESV)	6.76	6.31	10	7.04	4.21	9.99	**6.77**
Alt 2.a (TD on/off-Site)	7.63	6.20	10	5.89	5.61	7.66	**6.92**
Alt 2.b (TD on-Site)	7.54	6.95	10	6.01	5.59	7.66	**7.10**
Alt 2.c (TD off-Site)	4.81	4.12	10	6.19	3.57	7.66	**5.26**
Alt 3.a (IS-CO/S)	7.11	7.25	10	5.82	6.07	5.66	**6.98**
Alt 3.b (ES-CO/S)	7.63	7.19	10	5.70	6.11	5.66	**7.12**

ES-CO/S = ex situ chemical oxidation/reduction followed by stabilization
ESV = ex situ vitrification
IS-CO/S = in situ chemical oxidation/reduction followed by stabilization
ISV = in situ vitrification
TD = thermal desorption
TMV = toxicity, mobility, or volume

As required by CERCLA, evaluation of the alternatives relative to the criteria was done on an absolute basis using the decision support model. A relative evaluation was made to further assist in the overall determination and selection of the preferred alternative primarily due to the closeness of the alternative scores. The relative evaluation was made by taking the range of the absolute scores for given criteria and adjusting it to a 0-to-10 scale. A score between 0–2 was assigned a "low" ranking, 2–8 was assigned a "medium" ranking, and 8–10 was assigned a "high" ranking. The results of this relative scoring will be provided in the proposed plan and further support selection of ES-CO/S as the preferred alternative. Ex situ chemical oxidation/reduction followed by stabilization scored high on all criteria except reduction of TMV, which was scored low on a relative basis due to the volume increase of the final waste form created from this type of treatment. In addition, it is the lowest cost alternative.

The ES-CO/S alternative is preferred over the other alternatives, because it is a low-temperature operation, with a simplified off-gas treatment system, that generates a stabilized waste, which will be disposed of at the ICDF. Compared to the ISV alternative, ES-CO/S has fewer potential hazards to workers, fewer monitoring concerns, lower costs, and higher system reliability, which more than offsets ISV's relative strengths regarding technology maturity, less primary waste volume, and increased treatment capability for investigation-derived waste. Compared to the ESV alternative, ES-CO/S has fewer potential hazards to workers, lower costs, and higher system reliability. Compared to the TD on/off-Site alternative, ES-CO/S has more controllable disposal facilities, fewer off-Site shipments, and fewer potential hazards to workers, which more than offsets TD on/off-Site's increased administrative feasibility. Compared to the TD on-Site alternative, ES-CO/S has fewer potential hazards to workers and higher system reliability. Compared to TD off-Site, ES-CO/S has fewer potential hazards to workers, more readily available disposal facilities, lower costs, fewer required off-Site shipments, better system reliability, and a shorter ROD completion time. The ES-CO/S's only significant strength over IS-CO/S is that design and operational uncertainties are reduced.

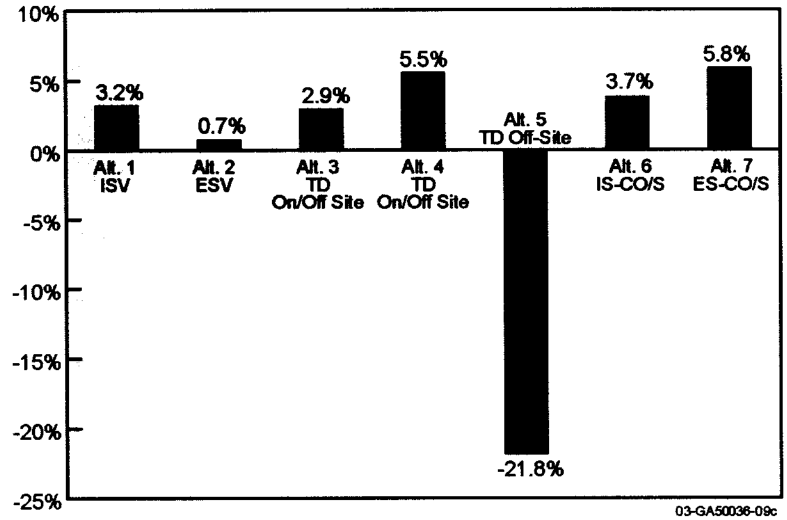


Figure 49. Summary scoring results for V-Tank remediation alternatives (deviation from the mean value rating for all seven technologies).

As noted in Section 1.2, it is currently assumed that the V-Tank waste is characteristically hazardous. This is a conservative assumption that stems from past analyses where the detection limits for some of the characteristically hazardous VOCs and SVOCs were above the regulatory limits. The actual concentration of these constituents is not known, but was conservatively assumed to be at the detection level. Future review of historical records and/or sampling, using lower detection limits, may be pursued to support the presumption that these trace contaminants might not be present in the V-Tank waste at characteristically hazardous levels. If this review/sampling shows that the hazardous VOCs and SVOCs are below regulatory levels, then the V-Tank waste will only require treatment of the listed constituent in the tank (i.e., the F001 hazardous organic, TCE). Otherwise, if the records review or sampling cannot negate the presence of these VOCs and SVOCs above regulatory levels, the V-Tank sludge will be treated as characteristically hazardous, thereby requiring additional treatment of the appropriate underlying hazardous constituents (e.g., PCBs and BEHP) to meet LDRs before disposal at the ICDF. Furthermore, in the unlikely event that the oxidant does not achieve LDR limits for certain VOCs, these can be evaporated from the waste and captured on a GAC filter. The GAC filter can subsequently be treated and disposed of. These considerations demonstrate the potential flexibility of ES-CO/S. (A more thorough discussion of the regulatory aspects is provided in the following section on ARARs.)

During the technology evaluation, a fact sheet (INEEL 2002b) was issued to the public identifying the need to modify the ROD and identifying the technologies being evaluated. Based on the fact sheet, briefings also were provided to four public stakeholder groups. Although input from the stakeholder groups (INEEL Citizens' Advisory Board, Coalition 21, Snake River Alliance, and Keep Yellowstone Nuclear Free) varied, it is generally perceived that the selected preferred alternative will find favor with the public primarily because it is a nonthermal process. (Note that formal community input on the preferred alternative will follow issuance of the proposed plan.)

Finally, these alternatives were evaluated based on the best available data at the time. It is recognized that additional alternatives (such as off-Site treatment systems) might become available in the future. In that event, the benefits of changing the specified remedy will be addressed.

6.2 Applicable or Relevant and Appropriate Requirements for the Preferred Alternative

The following potential ARARs have been generated specific to the preferred alternative. These will be modified, as necessary, and formally approved in the ROD amendment.

- CERCLA (40 CFR 300):
  - "Procedures for Planning and Implementing Off-Site Response Actions," 40 CFR 300.440
- "Rules for the Control of Air Pollution in Idaho" (IDAPA 58.01.01):
  - "Toxic Substances," IDAPA 58.01.01.161
  - "Toxic Air Pollutants Non-Carcinogenic Increments," IDAPA 58.01.01.585
  - "Toxic Air Pollutants Carcinogenic Increments," IDAPA 58.01.01.586
  - "Rules for Control of Fugitive Dust," IDAPA 58.01.01.650
  - "General Rules," IDAPA 58.01.01.651
  - "Compliance with Rules and Regulations," IDAPA 58.01.01.500.02
- "National Emission Standards for Hazardous Air Pollutants" (40 CFR 61):
  - "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities," 40 CFR 61, Subpart H
  - "Emission Monitoring and Test Procedures," 40 CFR 61.93
  - "Compliance and Reporting," 40 CFR 61.94
- RCRA—"Standards Applicable to Generators of Hazardous Waste" (40 CFR 262):
  - "Hazardous Waste Determination," 40 CFR 262.11
  - "The Manifest," 40 CFR 262, Subpart B
  - "Packaging," 40 CFR 262.30
  - "Labeling," 40 CFR 262.31
  - "Marking," 40 CFR 262.32
  - "Placarding," 40 CFR 262.33
- RCRA—"Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities" (40 CFR 264):
  - "Purpose, Scope, and Applicability," 40 CFR 264.1
  - "Closure and Performance Standards," 40 CFR 264.111

- "Disposal or Decontamination of Equipment, Structures, and Soils," 40 CFR 264.114
- "Use and Management of Containers," 40 CFR 264, Subpart I
- "Condition of Containers," 40 CFR 264.171
- "Compatibility of Waste with Containers," 40 CFR 264.172
- "Management of Containers," 40 CFR 264.173
- "Inspections," 40 CFR 264.174
- "Containment," 40 CFR 264.175
- "Special Requirements for Ignitable or Reactive Waste," 40 CFR 264.176
- "Special Requirements for Incompatible Wastes," 40 CFR 264.177
- "Closure," 40 CFR 264.178
- "Design and Installation of New Tank Systems or Components," 40 CFR 264.192
- "Containment and Detection of Releases," 40 CFR 264.193
- "General Operating Requirements," 40 CFR 264.194
- "Inspections," 40 CFR 264.195
- "Response to Leaks or Spills and Disposition of Leaking or Unfit-for-Use Tank Systems," 40 CFR 264.196
- "Closure and Post-Closure Care," 40 CFR 264.197
- "Temporary Units (TU)," 40 CFR 264.553
- "Air Emission Standards for Process Vents," 40 CFR 264 Subpart AA
- "Staging Piles," 40 CFR 264.554

- RCRA—"Land Disposal Restrictions" (40 CFR 268):
  - "Applicability of Treatment Standards," 40 CFR 268.40
  - "Variance from a Treatment Standard," 40 CFR 268.44
  - "Treatment Standards for Hazardous Debris," 40 CFR 268.45
  - "Universal Treatment Standards," 40 CFR 268.48
  - "Alternative LDR Treatment Standards for Contaminated Soil," 40 CFR 268.49

- TSCA—"Toxic Substance Control Act" (40 CFR 700–799):
  - "Marking Formats," 40 CFR 761.45
  - "Applicability," 40 CFR 761.50
  - "Storage for Disposal," 40 CFR 761.65
  - "PCB Remediation Waste," 40 CFR 761.61
  - "Storage for Disposal," 40 CFR 761.69
- To Be Considered:
  - "Radiation Protection of the Public and the Environment," DOE Order 5400.5, Chapter II (1)(a, b)
  - Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities.

6.2.1 Preliminary Resolution of Specific Applicable or Relevant and Appropriate Requirements

The following potential issues have been discussed with the Agencies and appear to be resolved through assignment of the associated ARARs and the subsequent submittal of the required documentation (e.g., risk-based petition and alternative treatment standards):

- Over approximately 30 years of operation, the V-Tanks collected waste from a multitude of processes at TAN. Typically, the waste was routed through Tank V-9 for solids removal and then collected in Tank V-1, Tank V-2, or Tank V-3, depending on the remaining available volume in each tank. Waste from multiple V-Tanks may be combined or mixed in various proportions for facilitating treatment by chemical oxidation/reduction and stabilization. All of the waste in Tanks V-1, V-2, V-3, and V-9 is considered one waste stream. Data from the various sampling events of the V-Tanks will be statistically combined (with the applicable statistical variance) to be representative of the entire waste stream. While concentrations of specific hazardous constituents may vary for each tank, the average concentration of the hazardous constituents (with applicable statistical variance) for all of the tanks will be used to determine applicable LDR treatment standards for the overall waste stream. Currently, the waste is characterized as F001. No other listed waste codes are applicable. Toxicity characteristic waste codes for non-F001 hazardous organic constituents or metals also could be applicable, depending on the results of further refined sampling that might be conducted. Sampling to date has not conclusively determined the applicability of these characteristic "D" codes due to interferences in the analysis. As a result of the detection limits for specific hazardous constituents exceeding the characteristic levels, it has been assumed that "D" characteristic codes are applicable. Treatment to meet the "D" code treatment standards and the UTS for all underlying hazardous constituents is planned, in addition to the applicable F001 treatment standards. If the additional sampling effort shows that the V-Tank waste does not exhibit any hazardous characteristic (no applicable "D" codes), then treatment goals will be modified to achieve compliance only with the applicable F001 treatment standard. The ROD amendment will address the results of the planned additional sampling and any modification of the treatment requirements.

- If the entire V-Tank waste stream has an average TCLP mercury concentration (with applicable statistical variance) that exceeds the characteristic toxicity level for mercury and exceeds 260 mg/kg of total mercury, then this waste will be subject to the LDR treatment standard of roasting or retorting mercury (RMERC) for high mercury waste. The RMERC standard was developed to promote recovery and recycling of mercury. Any mercury recovered from the V-Tanks via RMERC would remain radioactive and, thus, would not be recyclable. Therefore, because recycling that mercury would be inappropriate, the treatment standard of RMERC also is inappropriate. This provides the necessary rationale for preparing a petition for an alternative treatment standard under 40 CFR 268.44(a). A more appropriate alternative treatment standard would be to stabilize this mercury waste to reduce the mercury's leachability in this waste to less than 0.025 mg/L TCLP. This proposed alternative standard would be equivalent to the existing LDR treatment standard for low mercury waste. The ROD amendment will include that a petition requesting and justifying this alternative treatment standard has been prepared and approved, in accordance with the ARARs in 40 CFR 268.44(a).

- The waste in the V-Tanks is a sludge and contains PCBs over 50 mg/kg. As such, the V-Tank waste is regulated as a PCB remediation waste. Most of the PCBs are in the solid phase of the sludge. However, because the liquid phase will not be totally removed and the waste fails the paint filter test, the waste must still be regarded as a liquid PCB remediation waste under TSCA regulations. The treatment plan for this waste calls for chemical oxidation/reduction, stabilization, and disposal at the ICDF. The V-Tank waste currently meets the PCB concentration-based waste acceptance criteria (500 mg/kg) for disposal at the ICDF. However, management of liquid PCB remediation waste still requires approval under TSCA regulations. A risk-based petition under 40 CFR 761.61(c) will be prepared and submitted showing the planned treatment for the V-Tank waste, the final disposition at the ICDF, and the overall acceptable risk based on PCBs being managed according to this plan. As noted above, further sampling may be conducted to clarify whether the V-Tank waste is subject to further treatment standards based on a "D" characteristic code. It is currently assumed that "D" characteristic code(s) apply. Therefore, PCBs as an underlying hazardous constituent are planned to be treated to the RCRA UTS level of 10 mg/kg. The final treatment standard for PCBs will be determined due to the additional sampling. The ROD amendments will include that a risk-based petition has been prepared and approved, in accordance with the ARARs in 40 CFR 761.61(c).

- Any VOCs, mercury, or other hazardous constituents released during the chemical oxidation/reduction or stabilization processes and collected on the activated carbon, sulfur-impregnated carbon, or HEPA filters are considered a new waste stream with its own treatment requirements. These waste types will be characterized as F001 and then further characterized to determine if they exhibit any hazardous waste characteristics. Applicable treatment standards will be assigned based on these characterizations. These waste types will be tested to determine if they meet applicable LDR treatment standards, and they will be treated (as appropriate) after the treatment of the V-Tank waste is complete.

7. PREFERRED ALTERNATIVE PRESENTATION AND REMEDY SELECTION

The preferred alternative—chemical oxidation/reduction with stabilization—will be presented to the public for comment in a proposed plan, and the final remedy selection will be addressed in an amendment to the OU 1-10 ROD (DOE-ID 1999a). This section describes the process for presenting the preferred alternative to the public and selecting the new remedy. This section also identifies the deliverables and planned submittal dates for implementing the new remedy.

7.1 Proposed Plan and Record of Decision Amendment Process

A proposed plan will be prepared to present the preferred alternative to the public. Then, a ROD amendment will be prepared to select a new remedy for the V-Tanks. These documents will be prepared in accordance with the "National Oil and Hazardous Substances Pollution Contingency Plan" (40 CFR 300.435[c][2]) and EPA's guidance document, *A Guide to Preparing Superfund Proposed Plans, Records for Decision, and other Remedy Selection Decision Documents* (EPA 1999). In accordance with the Office of Solid Waste and Emergency Response guidance, a new proposed plan will be prepared and will include a 30-day public comment period. The proposed plan and ROD amendment preparation and review process will include the following steps:

- Prepare the draft proposed plan and submit to the Agencies for a 30-day review
- Place this Technology Evaluation Report in the Administrative Record
- Issue a public notice of availability for review and comment and a brief description of the proposed plan
- Make the proposed plan available for public comment
- Provide a 30-day period for submission of written or oral comments on the proposed plan. Upon timely request, extend the public comment period by at least 30 additional days
- Provide an opportunity for a public meeting
- Address and resolve, with Agency input, public comments
- Prepare the draft ROD amendment and submit to the Agencies for a 45-day review, followed by a 45-day comment resolution and incorporation period
- Include in the draft ROD amendment a responsiveness summary addressing each of the significant comments, criticisms, and any new, relevant information submitted during the public comment period of the proposed plan
- Publish the amended ROD
- Issue a public notice of availability (for information) of the amended ROD
- Place the amended ROD in the Administrative Record.

7.2 V-Tank Design Studies

Design studies will be conducted to confirm design parameters for the preferred alternative. The scope of these studies will be described in a design study work plan. Study results will be addressed in a design study report and will be used to provide information for the remedy detailed design.

7.3 V-Tanks Remedial Design/Remedial Action Scope of Work

A remedial design/remedial action scope of work for the V-Tanks will be prepared to outline scope and schedule for developing a new remedial design/remedial action work plan for the V-Tanks and supporting documents. The draft remedial design/remedial action scope of work will be submitted within 21 calendar days of the ROD amendment becoming final.

7.4 Deliverables and Working Schedule

Table 19 identifies the deliverables and working schedule dates for the proposed plan, ROD amendment, remedial design/remedial action scope of work for the V-Tanks, and design study work plan and report. This is an update to the deliverables table provided in Section 7 of the Technology Evaluation Scope of Work (DOE-ID 2002a).

Table 19. Deliverables for new V-Tank remedy implementation.

Deliverable	Planned Submittal Date	Enforceable Submittal Date	Review Duration in Calendar Days	Document Type
V-Tanks Proposed Plan and Record of Decision Amendment				
Draft Proposed Plan	1/31/03	NA	30	Secondary
Final Proposed Plan–Issued for Public Comment	4/13/03	NA	NA	
Draft ROD Amendment	7/31/03	12/31/03[a]	45	Primary
Draft Final ROD Amendment	10/30/03	NA	15	
Final ROD Amendment–Issued and Placed in Administrative Record	12/17/03	NA	NA	
Draft V-Tanks Remedial Design/Remedial Action Scope of Work	[b]	NA	30	Other
V-Tanks Preliminary Design Study				
Draft Design Study Work Plan	1/14/03	NA		Secondary
Draft Design Study Work Report	7/29/03	NA		Secondary

a. The enforceable date for the ROD amendment will be confirmed by a letter from the DOE-ID to the EPA and IDEQ.
b. The draft remedial design/remedial action scope of work will be submitted 21 calendar days after the ROD amendment becomes final.
DOE-ID = U.S. Department of Energy Idaho Operations Office
EPA = U.S. Environmental Protection Agency
IDEQ = Idaho Department of Environmental Quality
ROD = Record of Decision

8. REFERENCES

42 USC § 6901 et seq., 1976, "Resource Conservation and Recovery Act (Solid Waste Disposal Act)," *United States Code*, October 21, 1976.

42 USC § 9601 et seq., 1980, "Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA/Superfund)," *United States Code*, December 11, 1980.

40 CFR 61, 2003, "National Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, Office of the Federal Register, February 2003.

40 CFR 61, Subpart H, 2003, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities," *Code of Federal Regulations*, Office of the Federal Register, February 2003.

40 CFR 61.92, 2003, "Standard," *Code of Federal Regulations*, Office of the Federal Register, February 2003.

40 CFR 61.93, 2003, "Emission Monitoring and Test Procedures," *Code of Federal Regulations*, Office of the Federal Register, February 2003.

40 CFR 61.94, 2003, "Compliance and Reporting," *Code of Federal Regulations*, Office of the Federal Register, February 2003.

40 CFR 262, 2002, "Standards Applicable to Generators of Hazardous Waste," *Code of Federal Regulations*, Office of the Federal Register, February 2002.

40 CFR 262, Subpart B, 2002, "The Manifest," *Code of Federal Regulations*, Office of the Federal Register, February 2002.

40 CFR 262.11, 2002, "Hazardous Waste Determination," *Code of Federal Regulations*, Office of the Federal Register, February 2002.

40 CFR 262.30, 2002, "Packaging," *Code of Federal Regulations*, Office of the Federal Register, February 2002.

40 CFR 262.31, 2002, "Labeling," *Code of Federal Regulations*, Office of the Federal Register, February 2002.

40 CFR 262.32, 2002, "Marking," *Code of Federal Regulations*, Office of the Federal Register, February 2002.

40 CFR 262.33, 2002, "Placarding," *Code of Federal Regulations*, Office of the Federal Register, February 2002.

40 CFR 264, 2002, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264, Subpart I, 2002, "Use and Management of Containers," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.1, 2002, "Purpose, Scope, and Applicability," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.111, 2002, "Closure and Performance Standards," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.114, 2002, "Disposal or Decontamination of Equipment, Structures, and Soils," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.171, 2002, "Condition of Containers," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.172, 2002, "Compatibility of Waste with Containers," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.173, 2002, "Management of Containers," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.174, 2002, "Inspections," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.175, 2002, "Containment," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.176, 2002, "Special Requirements for Ignitable or Reactive Waste," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.177, 2002, "Special Requirements for Incompatible Wastes," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.178, 2002, "Closure," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.192, 2002, "Design and Installation of New Tank Systems or Components," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.193, 2002, "Containment and Detection of Releases," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.194, 2002, "General Operating Requirements," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.195, 2002, "Inspections," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.196, 2002, "Response to Leaks or Spills and Disposition of Leaking or Unfit-for-Use Tank Systems," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.197, 2002, "Closure and Post-Closure Care," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.553, 2002, "Temporary Units (TD)," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264.554, 2002, "Staging Piles," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 264, Subpart AA, 2002, "Air Emission Standards for Process Vents," *Code of Federal Regulations*, Office of the Federal Register, April 2002.

40 CFR 268, 2003, "Land Disposal Restrictions," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

40 CFR 268.40, 2003, "Applicability of Treatment Standards," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

40 CFR 268.44, 2003, "Variance from a Treatment Standard," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

40 CFR 268.45, 2003, "Treatment Standards for Hazardous Debris," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

40 CFR 268.48, 2003, "Universal Treatment Standards," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

40 CFR 268.49, 2003, "Alternative LDR Treatment Standards for Contaminated Soil," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

40 CFR 300, 2003, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*, Office of the Federal Register, March 2003.

40 CFR 300.430, 2003, "Remedial Investigation/Feasibility Study and Selection of Remedy," *Code of Federal Regulations*, Office of the Federal Register, March 2003.

40 CFR 300.440, 2003, "Procedures for Planning and Implementing Off-Site Response Actions," *Code of Federal Regulations*, Office of the Federal Register, March 2003.

40 CFR 700–799, 2002, "Toxic Substances Control Act," *Code of Federal Regulations*, Office of the Federal Register, February 2002.

40 CFR 761, 2003, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

40 CFR 761.45, 2003, "Marking Formats," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

40 CFR 761.50, 2003, "Applicability," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

40 CFR 761.61, 2003, "PCB Remediation Waste," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

40 CFR 761.62, 2003, "Disposal of PCB Bulk Product Waste," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

40 CFR 761.65, 2003, "Storage for Disposal," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

40 CFR 761.69, 2003, "Storage for Disposal," *Code of Federal Regulations*, Office of the Federal Register, January 2003.

DOE O 5400.5, 1993, "Radiation Protection of the Public and the Environment," U.S. Department of Energy, January 7, 1993.

Chem-Nuclear Systems, LLC, 2002, *Barnwell Waste Management Facility Site Disposal Criteria, Chem-Nuclear Systems Barnwell Office*, S20-AD-010, Revision 18, Chem-Nuclear Systems, LLC, Columbia, South Carolina, October 2002.

Corriveau, C. E. and D. F. Obenauer, 1995, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, BHI-00139, Bechtel Hanford, Inc., Richland, Washington, October 1995.

DOE/WIPP, 2002, *Contact-Handled Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, DOE/WIPP-02-3122, Revision 0.1, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico, July 2002.

DOE-ID, 1996, *Comprehensive Facility and Land Use Plan*, DOE/ID-10514, Revision 0, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho, March 1996.

DOE-ID, 1997, *Comprehensive Remedial Investigation/Feasibility Study for the Test Area North Operable Unit 1-10 at the Idaho National Engineering and Environmental Laboratory*, DOE/ID-10557, Revision 0, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho, November 1997.

DOE-ID, 1999a, *Final Record of Decision for Test Area North, Operable Unit 1-10*, DOE/ID-10682, Revision 0, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho, October 1999.

DOE-ID, 1999b, *Waste Area Group 5 Operable Unit 5-12 Comprehensive Remedial Investigation/Feasibility Study*, DOE/ID-10607, Revision 0, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho, January 1999.

DOE-ID, 2001, *Comprehensive Remedial Design/Remedial Action Work Plan for the Test Area North, Waste Area Group 1, Operable Unit 1-10, Group 2 Sites*, DOE/ID-10875, Revision 0, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho, November 2001.

DOE-ID, 2002a, *Technology Evaluation Scope of Work for the V-Tanks, TSF-09/18, at Waste Area Group 1, Operable Unit 1-10*, DOE/ID-10999, Revision 0, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho, July 2002.

DOE-ID, 2002b, *Idaho National Engineering and Environmental Laboratory Waste Acceptance Criteria*, DOE/ID-01-10381, Revision 16, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho, December 2002.

DOE-ID, 2002c, *Waste Acceptance Criteria for ICDF Landfill*, DOE/ID-10865, Revision 2, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho, May 2002.

EPA, 1998, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*, EPA/540/G-89/004, U.S. Environmental Protection Agency, October 1998.

EPA, 1999, *A Guide to Preparing Superfund Proposed Plans, Records for Decision, and other Remedy Selected Decision Documents*, OSWER 9200.1-23P, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, July 1999.

Hanford, 2002, *Hanford Site Solid Waste Acceptance Criteria*, HNF-EP-0063, Revision 7, Hanford Nuclear Facility, Richland, Washington, July 2002.

Idaho Code § 39-4401 et seq., "Hazardous Waste Management Act," State of Idaho Codes.

IDAPA 58.01.01, 1994, "Rules for the Control of Air Pollution in Idaho," Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, May 1994.

IDAPA 58.01.01.161, 1995, "Toxic Substances," Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, June 1995.

IDAPA 58.01.01.500.02, 1994, "Compliance with Rules and Regulations," Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, May 1994.

IDAPA 58.01.01.585, 1995, "Toxic Air Pollutants Non-Carcinogenic Increments," Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, June 1995.

IDAPA 58.01.01.586, 2001, "Toxic Air Pollutants Carcinogenic Increments," Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, March 2001.

IDAPA 58.01.01.650, 1994, "Rules for Control of Fugitive Dust," Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, May 1994.

IDAPA 58.01.01.651, 1994, "General Rules," Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, May 1994.

INEEL, 1998, *Final Report Treatability Study for LMITCO TSF-09 V-1, V-2, and V-3 Tank Waste*, INEEL/EXT-97-00739, Revision 0, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, September 1998.

INEEL, 2000, INEEL *Subsurface Disposal Area CERCLA-Based Screening Model*, INEEL/EXT-2000-00158, Revision 0, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, March 2000.

INEEL, 2002a, *Pre-Conceptual Designs of Various Alternatives for the V-Tanks, TSF-09/18 at Waste Area Group 1 Operable Unit 1-10*, INEEL/EXT-02-01310, Revision 0, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, November 2002.

INEEL, 2002b, *New Alternatives Considered for V-Tanks at Waste Area Group 1*, Fact Sheet, Doc. Id. 24747, Revision 0, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, August 2002.

NTS, 2002, *Nevada Test Site Waste Acceptance Criteria*, Revision 4, Nevada Test Site, February 2002.

Appendix A

Treatment Alternatives Cost Estimates

Project Summary Report

Project Name: ***WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate***
In Situ Vitrification
Project Location: ***INEEL - TAN***
Estimate Number: ***6303 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/J. D. Folker***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
01	01	Historical Costs Beginning @ ROD Acceptance &Ending 9/30/02	$5,985,323	$0	$0	0.00%	$5,985,323
03	03	Technology Evaluation, Proposed Plan and ROD Amendment	$723,469	$0	$180,867	25.00%	$904,336
04		Remedial Design & Supporting Documentation	$4,754,387	$0	$1,465,263	30.82%	$6,219,650
04.01	04	--Remedial Design PM	$1,451,410	$0	$362,853	25.00%	$1,814,263
04.02	04	--Group 2 RD/RA WP Addendum for Early RA	$469,963	$0	$117,491	25.00%	$587,454
04.03		--New Group 2 RD/RA WP & Supporting Documents	$1,966,213	$0	$768,219	39.07%	$2,734,432
04.03.04	**04**	**----Supporting Documents**	**$56,929**	**$0**	**$17,350**	**30.48%**	**$74,279**
04.03.05	**04**	**----SAR/TSR Addendum**	**$1,343,255**	**$0**	**$470,139**	**35.00%**	**$1,813,394**
04.03.06	**04**	**----Subcontractor DWEP (BBWI Review Costs)**	**$9,141**	**$0**	**$2,285**	**25.00%**	**$11,426**
04.03.07		**----IWCP**	**$556,889**	**$0**	**$278,444**	**50.00%**	**$835,333**
04.03.07.01	04	------IWCP for Site Preparations	$189,174	$0	$94,587	50.00%	$283,761
04.03.07.02	04	------IWCP for Tank Contents Removal and Treatment	$178,541	$0	$89,270	50.00%	$267,811
04.03.07.03	05	------IWCP for Tank and Ancillary Piping and Equipment	$189,174	$0	$94,587	50.00%	$283,761
04.04	05	--Readiness Review	$670,291	$0	$167,573	25.00%	$837,864
04.05	05	--RCRA Closure Plan	$179,272	$0	$44,818	25.00%	$224,090
04.06	06	--Project Closeout	$17,238	$0	$4,309	25.00%	$21,547
05		Remedial Action	$12,411,325	$0	$6,152,395	49.57%	$18,563,721
05.01	03	--Early Site Prep	$50,477	$0	$12,619	25.00%	$63,096
05.02		--Early Remediation Actions	$648,951	$0	$162,238	25.00%	$811,189
5.02.01		**----Tank Volume Monitoring**	**$227,315**	**$0**	**$56,829**	**25.00%**	**$284,144**
5.02.01.01	03	------Tank Level Monitoring During FY-03	$90,926	$0	$22,732	25.00%	$113,658
5.02.01.02	04	------Tank Level Monitoring During FY-04	$90,926	$0	$22,732	25.00%	$113,658
5.02.01.03	05	------Tank Level Monitoring During FY-05	$45,463	$0	$11,366	25.00%	$56,829

Project Summary Report

Project Name: ***WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate***
In Situ Vitrification
Project Location: ***INEEL - TAN***
Estimate Number: ***6303 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/J. D. Folker***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
5.02.02	**03**	**----Current Waste Management**	**$69,269**	**$0**	**$17,317**	**25.00%**	**$86,586**
5.02.03	**03**	**----Current Waste Disposition**	**$347,505**	**$0**	**$86,876**	**25.00%**	**$434,381**
5.02.04		**----Institutional Controls, Interface and Maintenance**	**$4,862**	**$0**	**$1,216**	**25.00%**	**$6,078**
5.02.04.01	03	------IC Control During FY-03	$1,945	$0	$486	25.00%	$2,431
5.02.04.02	04	------IC Control During FY-04	$1,945	$0	$486	25.00%	$2,431
5.02.04.03	05	------IC Control During FY-05	$972	$0	$243	25.00%	$1,215
05.03		--Remedial Action PM	$2,916,831	$0	$729,208	25.00%	$3,646,038
05.03.01	**05**	**----Remedial Action Pm During FY-05**	**$1,458,415**	**$0**	**$364,604**	**25.00%**	**$1,823,019**
05.03.02	**06**	**----Remedial Action Pm During FY-06**	**$1,458,415**	**$0**	**$364,604**	**25.00%**	**$1,823,019**
05.04	05	--In-Situ Vitrification Remedial Action	$8,795,067	$0	$5,248,331	59.67%	$14,043,398
06		FFA/CO Managment & Oversight 10/1/03 through 10/1/08	$4.213.604	$0	$1.053.401	25.00%	$5,267.004
06.01		--FFA/CO Management & Oversight	$3,994,436	$0	$998,609	25.00%	$4,993,045
06.01.01	**03**	**----Project Management & Support for FY-03**	**$836,436**	**$0**	**$209,109**	**25.00%**	**$1,045,545**
06.01.02	**04**	**----Project Management & Support for FY-04**	**$628,000**	**$0**	**$157,000**	**25.00%**	**$785,000**
06.01.03	**05**	**----Project Management & Support for FY-05**	**$1,025,000**	**$0**	**$256,250**	**25.00%**	**$1,281,250**
06.01.04	**06**	**----Project Management & Support for FY-06**	**$1,025,000**	**$0**	**$256,250**	**25.00%**	**$1,281,250**
06.01.05	**07**	**----Project Management & Support for FY-07**	**$480,000**	**$0**	**$120,000**	**25.00%**	**$600,000**
06.02		--Technology Evaluation, Proposed Plan & ROD Amendment	$219,168	$0	$54,792	25.00%	$273,959
06.02.01	**03**	**----Technology Evaluation & Report**	**$219,168**	**$0**	**$54,792**	**25.00%**	**$273,959**
07	05	G&A and Material Handling Fees	$87.028	$0	$21.757	25.00%	$108.785

Project Summary Report

Project Name: ***WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate***
In Situ Vitrification
Project Location: ***INEEL - TAN***
Estimate Number: ***6303 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/J. D. Folker***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
Total		In Situ Vitrification WAG 1 V-Tanks Life Cycle Estimate	$28,175,136	$0	$8,873,683	31.49%	$37,048,819

Net Present Value for Estimating Services File #6303 - Wag 1 V-Tanks In Situ Vitrification

A discount rate of 7%, as provided by the Office of Management and Budgets in Circular A-94, has been used. Per that circular, 7% yearly discount factors are to be used for the first 30 years with the 30 year factor used for all years greater than 30. The 7% discount rate assumes a 2.1% escalation rate. Because this escalation is accounted for in the discount rate, escalation values were removed from the cost estimate prior to use in this table.

Fiscal Year	Counting year	Expected Yearly Capital Cost	Expected Yearly O&M Cost	Expected Yearly Combined Capital and O&M Cost	Discount Factors for Mid Year 7%	Present Value of Capital Costs	Present Value of O&M Costs	Combined Capital and O&M Net Present Value
Totals		**$ 37,048,810**	**1,514,000**	**$ 38,562,810**		**$ 32,675,969**	**$ 275,300**	**$ 32,951,269**
pre FY 2003	0	$ 5,985,323		$ 5,985,323	1	$ 5,985,323		$ 5,985,323
FY 2003	1	$ 2,923,992		$ 2,923,992	0.9667	$ 2,826,623		$ 2,826,623
FY 2004	2	$ 5,753,477		$ 5,753,477	0.9035	$ 5,198,266		$ 5,198,266
FY 2005	3	$ 18,660,202		$ 18,660,202	0.8444	$ 15,756,675		$ 15,756,675
FY 2006	4	$ 3,125,816		$ 3,125,816	0.7891	$ 2,466,581		$ 2,466,581
FY 2007	5	$ 600,000	14,000	$ 614,000	0.7375	$ 442,500	$ 10,325	$ 452,825
FY 2012	10		75,000	$ 75,000	0.5258		$ 39,435	$ 39,435
FY 2017	15		75,000	$ 75,000	0.3749		$ 28,118	$ 28,118
FY 2022	20		75,000	$ 75,000	0.2673		$ 20,048	$ 20,048
FY 2027	25		75,000	$ 75,000	0.1906		$ 14,295	$ 14,295
FY 2032	30		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2037	35		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2042	40		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2047	45		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2052	50		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2057	55		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2062	60		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2067	65		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2072	70		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2077	75		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2082	80		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2087	85		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2092	90		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2097	95		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2102	100		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2107	105		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193

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Project Summary Report

Project Name: ***WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate Ex Situ Vitrification***
Project Location: ***INEEL - TAN***
Estimate Number: ***6302 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/J. D. Folker***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
01	01	Historical Costs Beginning @ ROD Acceptance &Ending 9/30/02	$5,985,323	$0	$0	0.00%	$5,985,323
03	03	Technology Evaluation. Proposed Plan and ROD Amendment	$723,469	$0	$180,867	25.00%	$904,336
04		Remedial Design & Supporting Documentation	$4,754,387	$0	$1,466,306	30.84%	$6,220,693
04.01	04	--Remedial Design PM	$1,451,410	$0	$362,853	25.00%	$1,814,263
04.02	04	--Group 2 RD/RA WP Addendum for Early RA	$469,963	$0	$117,491	25.00%	$587,454
04.03		--New Group 2 RD/RA WP & Supporting Documents	$1,966,213	$0	$769,262	39.12%	$2,735,475
04.03.04	**04**	**----Supporting Documents**	**$56,929**	**$0**	**$18,393**	**32.31%**	**$75,322**
04.03.04.01		------FSP	$41,283	$0	$11,353	27.50%	$52,636
04.03.04.02		------HASP	$15,646	$0	$7,041	45.00%	$22,686
04.03.05	**04**	**----SAR/TSR Addendum**	**$1,343,255**	**$0**	**$470,139**	**35.00%**	**$1,813,394**
04.03.06	**04**	**----Subcontractor DWEP (BBWI Review Costs)**	**$9,141**	**$0**	**$2,285**	**25.00%**	**$11,426**
04.03.07		**----IWCP**	**$556,889**	**$0**	**$278,444**	**50.00%**	**$835,333**
04.03.07.01	04	------IWCP for Site Preparations	$189,174	$0	$94,587	50.00%	$283,761
04.03.07.02	04	------IWCP for Tank Contents Removal and Treatment	$178,541	$0	$89,270	50.00%	$267,811
04.03.07.03	05	------IWCP for Tank and Ancillary Piping and Equipment	$189,174	$0	$94,587	50.00%	$283,761
04.04	05	--Readiness Assessment	$670,291	$0	$167,573	25.00%	$837,864
04.05	05	--RCRA Closure Plan	$179,272	$0	$44,818	25.00%	$224,090
04.06	06	--Project Closeout	$17,238	$0	$4,309	25.00%	$21,547
05		Remedial Action	$12,228,029	$0	$6,053,017	49.50%	$18,281,046
05.01	03	--Early Site Prep	$50,477	$0	$12,619	25.00%	$63,096
05.02	03	--Early Remediation Actions	$648,951	$0	$162,238	25.00%	$811,189
5.02.01		**----Tank Volume Monitoring**	**$227,315**	**$0**	**$56,829**	**25.00%**	**$284,144**
5.02.01.01	03	------Tank Level Monitoring During FY-03	$90,926	$0	$22,732	25.00%	$113,658

Project Summary Report

Project Name: ***WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate Ex Situ Vitrification***
Project Location: ***INEEL - TAN***
Estimate Number: ***6302 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/J. D. Folker***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
5.02.01.02	04	------Tank Level Monitoring During FY-04	$90,926	$0	$22,732	25.00%	$113,658
5.02.01.03	05	------Tank Level Monitoring During FY-05	$45,463	$0	$11,366	25.00%	$56,829
5.02.02	**03**	**----Current Waste Management**	**$69,269**	**$0**	**$17,317**	**25.00%**	**$86,586**
5.02.03	**03**	**----Current Waste Disposition**	**$347,505**	**$0**	**$86,876**	**25.00%**	**$434,381**
5.02.04		**----Institutional Controls, Interface and Maintenance**	**$4,862**	**$0**	**$1,216**	**25.00%**	**$6,078**
5.02.04.01	03	------IC Control During FY-03	$1,945	$0	$486	25.00%	$2,431
5.02.04.02	04	------IC Control During FY-04	$1,945	$0	$486	25.00%	$2,431
5.02.04.03	05	------IC Control During FY-05	$972	$0	$243	25.00%	$1,215
05.03		--Remedial Action PM	$2,916,831	$0	$729,208	25.00%	$3,646,038
05.03.01	**05**	**----Remedial Action Pm During FY-05**	**$1,458,415**	**$0**	**$364,604**	**25.00%**	**$1,823,019**
05.03.02	**06**	**----Remedial Action Pm During FY-06**	**$1,458,415**	**$0**	**$364,604**	**25.00%**	**$1,823,019**
05.04	05	--Ex-Situ Vitrification	$8,611,771	$0	$5,148,953	59.79%	$13,760,723
06		FFA/CO Managment & Oversight 10/1/03 through 10/1/08	$4,213,604	$0	$1,053,401	25.00%	$5,267,004
06.01		--FFA/CO Management & Oversight	$3,994,436	$0	$998,609	25.00%	$4,993,045
06.01.01	**03**	**----Project Management & Support for FY-03**	**$836,436**	**$0**	**$209,109**	**25.00%**	**$1,045,545**
06.01.02	**04**	**----Project Management & Support for FY-04**	**$628,000**	**$0**	**$157,000**	**25.00%**	**$785,000**
06.01.03	**05**	**----Project Management & Support for FY-05**	**$1,025,000**	**$0**	**$256,250**	**25.00%**	**$1,281,250**
06.01.04	**06**	**----Project Management & Support for FY-06**	**$1,025,000**	**$0**	**$256,250**	**25.00%**	**$1,281,250**
06.01.05	**07**	**----Project Management & Support for FY-07**	**$480,000**	**$0**	**$120,000**	**25.00%**	**$600,000**
06.02		--Technology Evaluation, Proposed Plan & ROD Amendment	$219,168	$0	$54,792	25.00%	$273,959
06.02.01	**03**	**----Technology Evaluation & Report**	**$219,168**	**$0**	**$54,792**	**25.00%**	**$273,959**
07	05	G&A and Material Handling Fees	$87,028	$0	$21,757	25.00%	$108,785

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Project Summary Report

Project Name: ***WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate***
Ex Situ Vitrification
Project Location: ***INEEL - TAN***
Estimate Number: ***6302 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/J. D. Folker***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
Total		Ex Situ Vitrification WAG 1 V-Tanks Life Cycle Estimate	$27,991,839	$0	$8,775,348	31.35%	$36,767,187

Net Present Value for Estimating Services File #6302 - Wag 1 V-Tanks Ex Situ Vitrification

A discount rate of 7%, as provided by the Office of Management and Budgets in Circular A-94, has been used. Per that circular, 7% yearly discount factors are to be used for the first 30 years with the 30 year factor used for all years greater than 30. The 7% discount rate assumes a 2.1% escalation rate. Because this escalation is accounted for in the discount rate, escalation values were removed from the cost estimate prior to use in this table.

Fiscal Year	Counting year	Expected Yearly Capital Cost	Expected Yearly O&M Cost	Expected Yearly Combined Capital and O&M Cost	Discount Factors for Mid Year 7%	Present Value of Capital Costs	Present Value of O&M Costs	Combined Capital and O&M Net Present Value
Totals		**$ 36,767,187**	**1,514,000**	**$ 38,281,187**		**$ 32,438,228**	**$ 275,300**	**$ 32,713,528**
pre FY 2003	0	$ 5,985,323		$ 5,985,323	1	$ 5,985,323		$ 5,985,323
FY 2003	1	$ 2,923,992		$ 2,923,992	0.9667	$ 2,826,623		$ 2,826,623
FY 2004	2	$ 5,754,520		$ 5,754,520	0.9035	$ 5,199,209		$ 5,199,209
FY 2005	3	$ 18,377,536		$ 18,377,536	0.8444	$ 15,517,991		$ 15,517,991
FY 2006	4	$ 3,125,816		$ 3,125,816	0.7891	$ 2,466,581		$ 2,466,581
FY 2007	5	$ 600,000	14,000	$ 614,000	0.7375	$ 442,500	$ 10,325	$ 452,825
FY 2012	10		75,000	$ 75,000	0.5258		$ 39,435	$ 39,435
FY 2017	15		75,000	$ 75,000	0.3749		$ 28,118	$ 28,118
FY 2022	20		75,000	$ 75,000	0.2673		$ 20,048	$ 20,048
FY 2027	25		75,000	$ 75,000	0.1906		$ 14,295	$ 14,295
FY 2032	30		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2037	35		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2042	40		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2047	45		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2052	50		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2057	55		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2062	60		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2067	65		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2072	70		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2077	75		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2082	80		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2087	85		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2092	90		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2097	95		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2102	100		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2107	105		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193

Project Summary Report

Project Name: ***WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate***
Thermal Desorption Option #1
Project Location: ***INEEL - TAN***
Estimate Number: ***6306 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/D. T. Peterson***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
01		Historical Costs Beginning @ ROD Acceptance &Ending 9/30/02	$5.985.323	$0	$0	0.00%	$5.985.323
03	03	Technology Evaluation. Proposed Plan and ROD Amendment	$723.469	$0	$180.867	25.00%	$904.336
04		Remedial Design & Supporting Documentation	$4.680.730	$0	$1.381.447	29.51%	$6.062.177
04.01	04	--Remedial Design PM	$1,451,410	$0	$362,853	25.00%	$1,814,263
04.02	04	--Group 2 RD/RA WP Addendum for Early RA	$469,963	$0	$117,491	25.00%	$587,454
04.03		--New Group 2 RD/RA WP & Supporting Documents	$1,961,072	$0	$701,533	35.77%	$2,662,604
04.03.04	**04**	**----Supporting Documents**	**$52,894**	**$0**	**$18,103**	**34.23%**	**$70,997**
04.03.05	**04**	**----SAR/TSR Addendum**	**$1,343,255**	**$0**	**$402,977**	**30.00%**	**$1,746,232**
04.03.06	**04**	**----Subcontractor DWEP (BBWI Review Costs)**	**$8,034**	**$0**	**$2,009**	**25.00%**	**$10,043**
04.03.07		**----IWCP**	**$556,889**	**$0**	**$278,444**	**50.00%**	**$835,333**
04.03.07.01	04	------IWCP for Site Preparations	$189,174	$0	$94,587	50.00%	$283,761
04.03.07.02	04	------IWCP for Tank Contents Removal and Treatment	$178,541	$0	$89,270	50.00%	$267,811
04.03.07.03	05	------IWCP for Tank and Ancillary Piping and Equipment	$189,174	$0	$94,587	50.00%	$283,761
04.04	05	--Readiness Assessment	$603,540	$0	$150,885	25.00%	$754,425
04.05	05	--RCRA Closure Plan	$179,272	$0	$44,818	25.00%	$224,090
04.06	06	--Project Closeout	$15,474	$0	$3,868	25.00%	$19,342
05		Remedial Action	$10.646.165	$0	$4,908.166	46.10%	$15.554.331
05.01	03	--Early Site Prep	$50,477	$0	$12,619	25.00%	$63,096
05.02		--Early Remediation Actions	$648,951	$0	$162,238	25.00%	$811,189
5.02.01		**----Tank Volume Monitoring**	**$227,315**	**$0**	**$56,829**	**25.00%**	**$284,144**
5.02.01.01	03	------Tank Level Monitoring During FY-03	$90,926	$0	$22,732	25.00%	$113,658
5.02.01.02	04	------Tank Level Monitoring During FY-04	$90,926	$0	$22,732	25.00%	$113,658
5.02.01.03	05	------Tank Level Monitoring During FY-05	$45,463	$0	$11,366	25.00%	$56,829

Project Summary Report

Project Name: *WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate Thermal Desorption Option #1*
Project Location: *INEEL - TAN*
Estimate Number: *6306 (Wallace 2002)*

Client: *J. J. Jessmore*
Prepared By: *B. W. Wallace/D. T. Peterson*
Estimate Type: *Project Support*

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
5.02.02	03	----Current Waste Management	$69,269	$0	$17,317	25.00%	$86,586
5.02.03	03	----Current Waste Disposition	$347,505	$0	$86,876	25.00%	$434,381
5.02.04		----Institutional Controls, Interface and Maintenance	$4,862	$0	$1,216	25.00%	$6,078
5.02.04.01	03	------IC Control During FY-03	$1,945	$0	$486	25.00%	$2,431
5.02.04.02	04	------IC Control During FY-04	$1,945	$0	$486	25.00%	$2,431
5.02.04.03	05	------IC Control During FY-05	$972	$0	$243	25.00%	$1,215
05.03		--Remedial Action PM	$2,916,831	$0	$729,208	25.00%	$3,646,038
05.03.01	05	----Remedial Action Pm During FY-05	$1,458,415	$0	$364,604	25.00%	$1,823,019
05.03.02	06	----Remedial Action Pm During FY-06	$1,458,415	$0	$364,604	25.00%	$1,823,019
05.04	05	--Remedial Action	$7,029,907	$0	$4,004,102	56.96%	$11,034,009
06		FFA/CO Managment & Oversight 10/1/03 through 10/1/08	$4,213,604	$0	$1,053,401	25.00%	$5,267,004
06.01		--FFA/CO Management & Oversight	$3,994,436	$0	$998,609	25.00%	$4,993,045
06.01.01	03	----Project Management & Support for FY-03	$836,436	$0	$209,109	25.00%	$1,045,545
06.01.02	04	----Project Management & Support for FY-04	$628,000	$0	$157,000	25.00%	$785,000
06.01.03	05	----Project Management & Support for FY-05	$1,025,000	$0	$256,250	25.00%	$1,281,250
06.01.04	06	----Project Management & Support for FY-06	$1,025,000	$0	$256,250	25.00%	$1,281,250
06.01.05	07	----Project Management & Support for FY-07	$480,000	$0	$120,000	25.00%	$600,000
06.02	03	--Technology Evaluation, Proposed Plan & ROD Amendment	$219,168	$0	$54,792	25.00%	$273,959
07	05	G&A and Material Handling Fees	$87,028	$0	$21,757	25.00%	$108,785
Total		Thermal Desorption Option #1 WAG 1 V-Tanks Life Cycle Estimate	$26,336,319	$0	$7,545,639	28.65%	$33,881,957

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Net Present Value for Estimating Services File #6306 - Wag 1 V-Tanks Thermal Desorption Option #1

A discount rate of 7%, as provided by the Office of Management and Budgets in Circular A-94, has been used. Per that circular, 7% yearly discount factors are to be used for the first 30 years with the 30 year factor used for all years greater than 30. The 7% discount rate assumes a 2.1% escalation rate. Because this escalation is accounted for in the discount rate, escalation values were removed from the cost estimate prior to use in this table

Fiscal Year	Counting year	Expected Yearly Capital Cost	Expected Yearly O&M Cost	Expected Yearly Combined Capital and O&M Cost	Discount Factors for Mid Year 7%	Present Value of Capital Costs	Present Value of O&M Costs	Combined Capital and O&M Net Present Value
Totals		**$ 33,881,959**	**1,514,000**	**$ 35,395,959**		**$ 29,997,756**	**$ 275,300**	**$ 30,273,056**
pre FY 2003	0	$ 5,985,323		$ 5,985,323	1	$ 5,985,323		$ 5,985,323
FY 2003	1	$ 2,923,992		$ 2,923,992	0.9667	$ 2,826,623		$ 2,826,623
FY 2004	2	$ 5,681,650		$ 5,681,650	0.9035	$ 5,133,371		$ 5,133,371
FY 2005	3	$ 15,567,383		$ 15,567,383	0.8444	$ 13,145,098		$ 13,145,098
FY 2006	4	$ 3,123,611		$ 3,123,611	0.7891	$ 2,464,841		$ 2,464,841
FY 2007	5	$ 600,000	14,000	$ 614,000	0.7375	$ 442,500	$ 10,325	$ 452,825
FY 2012	10		75,000	$ 75,000	0.5258		$ 39,435	$ 39,435
FY 2017	15		75,000	$ 75,000	0.3749		$ 28,118	$ 28,118
FY 2022	20		75,000	$ 75,000	0.2673		$ 20,048	$ 20,048
FY 2027	25		75,000	$ 75,000	0.1906		$ 14,295	$ 14,295
FY 2032	30		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2037	35		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2042	40		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2047	45		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2052	50		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2057	55		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2062	60		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2067	65		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2072	70		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2077	75		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2082	80		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2087	85		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2092	90		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2097	95		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2102	100		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2107	105		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193

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Project Summary Report

Project Name: ***WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate***
Thermal Desorption Option #2
Project Location: ***INEEL - TAN***
Estimate Number: ***6307 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/D. T. Peterson***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
01	01	Historical Costs Beginning @ ROD Acceptance &Ending 9/30/02	$5,985,323	$0	$0	0.00%	$5,985,323
03	03	Technology Evaluation, Proposed Plan and ROD Amendment	$723,469	$0	$180,867	25.00%	$904,336
04		Remedial Design & Supporting Documentation	$4,680,730	$0	$1,381,447	29.51%	$6,062,177
04.01	04	--Remedial Design PM	$1,451,410	$0	$362,853	25.00%	$1,814,263
04.02	04	--Group 2 RD/RA WP Addendum for Early RA	$469,963	$0	$117,491	25.00%	$587,454
04.03		--New Group 2 RD/RA WP & Supporting Documents	$1,961,072	$0	$701,533	35.77%	$2,662,604
04.03.04	**04**	**----Supporting Documents**	**$52,894**	**$0**	**$18,103**	**34.23%**	**$70,997**
04.03.05	**04**	**----SAR/TSR Addendum**	**$1,343,255**	**$0**	**$402,977**	**30.00%**	**$1,746,232**
04.03.06	**04**	**----Subcontractor DWEP (BBWI Review Costs)**	**$8,034**	**$0**	**$2,009**	**25.00%**	**$10,043**
04.03.07		**----IWCP**	**$556,889**	**$0**	**$278,444**	**50.00%**	**$835,333**
04.03.07.01	04	------IWCP for Site Preparations	$189,174	$0	$94,587	50.00%	$283,761
04.03.07.02	04	------IWCP for Tank Contents Removal and Treatment	$178,541	$0	$89,270	50.00%	$267,811
04.03.07.03	05	------IWCP for Tank and Ancillary Piping and Equipment	$189,174	$0	$94,587	50.00%	$283,761
04.04	05	--Readiness Assessment	$603,540	$0	$150,885	25.00%	$754,425
04.05	05	--RCRA Closure Plan	$179,272	$0	$44,818	25.00%	$224,090
04.06	06	--Project Closeout	$15,474	$0	$3,868	25.00%	$19,342
05		Remedial Action	$10,619,163	$0	$4,997,103	47.06%	$15,616,265
05.01	03	--Early Site Prep	$50,477	$0	$12,619	25.00%	$63,096
05.02		--Early Remediation Actions	$648,951	$0	$162,238	25.00%	$811,189
5.02.01		**----Tank Volume Monitoring**	**$227,315**	**$0**	**$56,829**	**25.00%**	**$284,144**
5.02.01.01	03	------Tank Level Monitoring During FY-03	$90,926	$0	$22,732	25.00%	$113,658
5.02.01.02	04	------Tank Level Monitoring During FY-04	$90,926	$0	$22,732	25.00%	$113,658
5.02.01.03	05	------Tank Level Monitoring During FY-05	$45,463	$0	$11,366	25.00%	$56,829

Project Summary Report

Project Name: *WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate Thermal Desorption Option #2*
Project Location: *INEEL - TAN*
Estimate Number: *6307 (Wallace 2002)*

Client: *J. J. Jessmore*
Prepared By: *B. W. Wallace/D. T. Peterson*
Estimate Type: *Project Support*

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
5.02.02	03	----Current Waste Management	$69,269	$0	$17,317	25.00%	$86,586
5.02.03	03	----Current Waste Disposition	$347,505	$0	$86,876	25.00%	$434,381
5.02.04		----Institutional Controls, Interface and Maintenance	$4,862	$0	$1,216	25.00%	$6,078
5.02.04.01	03	------IC Control During FY-03	$1,945	$0	$486	25.00%	$2,431
5.02.04.02	04	------IC Control During FY-04	$1,945	$0	$486	25.00%	$2,431
5.02.04.03	05	------IC Control During FY-05	$972	$0	$243	25.00%	$1,215
05.03		--Remedial Action PM	$2,916,831	$0	$729,208	25.00%	$3,646,038
05.03.01	05	----Remedial Action Pm During FY-05	$1,458,415	$0	$364,604	25.00%	$1,823,019
05.03.02	06	----Remedial Action Pm During FY-06	$1,458,415	$0	$364,604	25.00%	$1,823,019
05.04	05	--Remedial Action	$7,002,905	$0	$4,093,038	58.45%	$11,095,943
06		FFA/CO Managment & Oversight 10/1/03 through 10/1/08	$4,213,604	$0	$1,053,401	25.00%	$5,267,004
06.01		--FFA/CO Management & Oversight	$3,994,436	$0	$998,609	25.00%	$4,993,045
06.01.01	03	----Project Management & Support for FY-03	$836,436	$0	$209,109	25.00%	$1,045,545
06.01.02	04	----Project Management & Support for FY-04	$628,000	$0	$157,000	25.00%	$785,000
06.01.03	05	----Project Management & Support for FY-05	$1,025,000	$0	$256,250	25.00%	$1,281,250
06.01.04	06	----Project Management & Support for FY-06	$1,025,000	$0	$256,250	25.00%	$1,281,250
06.01.05	07	----Project Management & Support for FY-07	$480,000	$0	$120,000	25.00%	$600,000
06.02	03	--Technology Evaluation, Proposed Plan & ROD Amendment	$219,168	$0	$54,792	25.00%	$273,959
07	05	G&A and Material Handling Fees	$87,028	$0	$21,757	25.00%	$108,785
Total		Thermal Desorption Option #2 - WAG 1 V-Tanks Life Cycle Estimate	$26,309,316	$0	$7,634,575	29.02%	$33,943,891

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Net Present Value for Estimating Services File #6307 - Wag 1 V-Tanks Thermal Desorption Option #2

A discount rate of 7%, as provided by the Office of Management and Budgets in Circular A-94, has been used. Per that circular, 7% yearly discount factors are to be used for the first 30 years with the 30 year factor used for all years greater than 30. The 7% discount rate assumes a 2.1% escalation rate. Because this escalation is accounted for in the discount rate, escalation values were removed from the cost estimate prior to use in this table.

Fiscal Year	Counting year	Expected Yearly Capital Cost	Expected Yearly O&M Cost	Expected Yearly Combined Capital and O&M Cost	Discount Factors for Mid Year 7%	Present Value of Capital Costs	Present Value of O&M Costs	Combined Capital and O&M Net Present Value
Totals		**$ 33,943,893**	**1,514,000**	**$ 35,457,893**		**$ 30,050,054**	**$ 275,300**	**$ 30,325,354**
pre FY 2003	0	$ 5,985,323		$ 5,985,323	1	$ 5,985,323		$ 5,985,323
FY 2003	1	$ 2,923,992		$ 2,923,992	0.9667	$ 2,826,623		$ 2,826,623
FY 2004	2	$ 5,681,650		$ 5,681,650	0.9035	$ 5,133,371		$ 5,133,371
FY 2005	3	$ 15,629,317		$ 15,629,317	0.8444	$ 13,197,395		$ 13,197,395
FY 2006	4	$ 3,123,611		$ 3,123,611	0.7891	$ 2,464,841		$ 2,464,841
FY 2007	5	$ 600,000	14,000	$ 614,000	0.7375	$ 442,500	$ 10,325	$ 452,825
FY 2012	10		75,000	$ 75,000	0.5258		$ 39,435	$ 39,435
FY 2017	15		75,000	$ 75,000	0.3749		$ 28,118	$ 28,118
FY 2022	20		75,000	$ 75,000	0.2673		$ 20,048	$ 20,048
FY 2027	25		75,000	$ 75,000	0.1906		$ 14,295	$ 14,295
FY 2032	30		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2037	35		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2042	40		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2047	45		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2052	50		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2057	55		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2062	60		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2067	65		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2072	70		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2077	75		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2082	80		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2087	85		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2092	90		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2097	95		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2102	100		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2107	105		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193

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Project Summary Report

Project Name: ***WAG 1 V-Tanks Technical Evaluation Life Cycle Estimate***
Thermal Desorption Option #3
Project Location: ***INEEL - TAN***
Estimate Number: ***6308 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/D. T. Peterson***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
01	01	Historical Costs Beginning @ ROD Acceptance &Ending 9/30/02	$5,985,323	$0	$0	0.00%	$5,985,323
03	03	Technology Evaluation, Proposed Plan and ROD Amendment	$723,469	$0	$180,867	25.00%	$904,336
04		Remedial Design & Supporting Documentation	$4,752,623	$0	$1,399,723	29.45%	$6,152,346
04.01	04	--Remedial Design PM	$1,451,410	$0	$362,853	25.00%	$1,814,263
04.01.01		**----Project Management During Remedial Design FY-04**	**$1,451,410**	**$0**	**$362,853**	**25.00%**	**$1,814,263**
04.02	04	--Group 2 RD/RA WP Addendum for Early RA	$469,963	$0	$117,491	25.00%	$587,454
04.02.01		**----Design Study for Early RA**	**$34,921**	**$0**	**$8,730**	**25.00%**	**$43,651**
04.02.02		**----Revision of SAR/TSR for Early RA**	**$42,108**	**$0**	**$10,527**	**25.00%**	**$52,635**
04.02.03		**----Group 2 RD/RA WP Addendum for V-Tanks Early RA**	**$182,548**	**$0**	**$45,637**	**25.00%**	**$228,185**
04.02.04		**----V-Tanks ESD for Early RA**	**$72,754**	**$0**	**$18,189**	**25.00%**	**$90,943**
04.02.05		**----V-Tanks FSP for Early RA**	**$100,350**	**$0**	**$25,088**	**25.00%**	**$125,438**
04.02.06		**----V-Tanks HASP for Early RA**	**$37,282**	**$0**	**$9,321**	**25.00%**	**$46,603**
04.03		--New Group 2 RD/RA WP & Supporting Documents	$1,966,213	$0	$703,120	35.76%	$2,669,334
04.03.04	**04**	**----Supporting Documents**	**$56,929**	**$0**	**$19,414**	**34.10%**	**$76,343**
04 03.04.01		------FSP	$41,283	$0	$13,417	32.50%	$54,700
04.03.04.02		------HASP	$15,646	$0	$5,997	38.33%	$21,643
04.03.05	**04**	**----SAR/TSR Addendum**	**$1,343,255**	**$0**	**$402,977**	**30.00%**	**$1,746,232**
04.03.06	**06**	**----Subcontractor DWEP (BBWI Review Costs)**	**$9,141**	**$0**	**$2,285**	**25.00%**	**$11,426**
04.03.07		**----IWCP**	**$556,889**	**$0**	**$278,444**	**50.00%**	**$835,333**
04.04	05	--Readiness Assessment	$670,291	$0	$167,573	25.00%	$837,864
04.05	05	--RCRA Closure Plan	$179,272	$0	$44,818	25.00%	$224,090
04.06	06	--Project Closeout	$15,474	$0	$3,868	25.00%	$19,342

Project Summary Report

Project Name: ***WAG 1 V-Tanks Technical Evaluation Life Cycle Estimate Thermal Desorption Option #3***
Project Location: ***INEEL - TAN***
Estimate Number: ***6308 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/D. T. Peterson***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
05		Remedial Action	$12.449.391	$0	$7.181.846	57.69%	$19.631.237
06		FFA/CO Managment & Oversight 10/1/03 through 10/1/08	$4.213.604	$0	$1.053.401	25.00%	$5.267.004
07	05	G&A and Material Handling Fees	$87.028	$0	$21.757	25.00%	$108.785
Total		**WAG 1 V-Tanks Life Cycle Estimate - Thermal Desorption - Option #3**	**$28,211,438**	**$0**	**$9,837,594**	**34.87%**	**$38,049,032**

Net Present Value for Estimating Services File #6308 - Wag 1 V-Tanks Thermal Desorption Option #3

A discount rate of 7%, as provided by the Office of Management and Budgets in Circular A-94, has been used. Per that circular, 7% yearly discount factors are to be used for the first 30 years with the 30 year factor used for all years greater than 30. The 7% discount rate assumes a 2.1% escalation rate. Because this escalation is accounted for in the discount rate, escalation values were removed from the cost estimate prior to use in this table.

Fiscal Year	Counting year	Expected Yearly Capital Cost	Expected Yearly O&M Cost	Expected Yearly Combined Capital and O&M Cost	Discount Factors for Mid Year 7%	Present Value of Capital Costs	Present Value of O&M Costs	Combined Capital and O&M Net Present Value
Totals		**$ 38,049,033**	**1,514,000**	**$ 39,563,033**		**$ 33,516,831**	**$ 275,300**	**$ 33,792,131**
pre FY 2003	0	$ 5,985,323		$ 5,985,323	1	$ 5,985,323		$ 5,985,323
FY 2003	1	$ 2,923,992		$ 2,923,992	0.9667	$ 2,826,623		$ 2,826,623
FY 2004	2	$ 5,688,379		$ 5,688,379	0.9035	$ 5,139,450		$ 5,139,450
FY 2005	3	$ 19,727,728		$ 19,727,728	0.8444	$ 16,658,094		$ 16,658,094
FY 2006	4	$ 3,123,611		$ 3,123,611	0.7891	$ 2,464,841		$ 2,464,841
FY 2007	5	$ 600,000	14,000	$ 614,000	0.7375	$ 442,500	$ 10,325	$ 452,825
FY 2012	10		75,000	$ 75,000	0.5258		$ 39,435	$ 39,435
FY 2017	15		75,000	$ 75,000	0.3749		$ 28,118	$ 28,118
FY 2022	20		75,000	$ 75,000	0.2673		$ 20,048	$ 20,048
FY 2027	25		75,000	$ 75,000	0.1906		$ 14,295	$ 14,295
FY 2032	30		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2037	35		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2042	40		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2047	45		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2052	50		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2057	55		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2062	60		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2067	65		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2072	70		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2077	75		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2082	80		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2087	85		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2092	90		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2097	95		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2102	100		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2107	105		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193

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Project Summary Report

Project Name: ***WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate***
IN Situ Chemical Oxidation & Grouting
Project Location: ***INEEL - TAN***
Estimate Number: ***6305 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/R. D. R/R. D. A.***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
01	01	Historical Costs Beginning @ ROD Acceptance &Ending 9/30/02	$5,985,323	$0	$0	0.00%	$5,985,323
03	03	Technology Evaluation, Proposed Plan and ROD Amendment	$723,469	$0	$180,867	25.00%	$904,336
04		Remedial Design & Supporting Documentation	$4,754,387	$0	$1,335,587	28.09%	$6,089,974
04.01	04	--Remedial Design PM	$1,451,410	$0	$362,853	25.00%	$1,814,263
04.02	04	--Group 2 RD/RA WP Addendum for Early RA	$469,963	$0	$117,491	25.00%	$587,454
04.03		--New Group 2 RD/RA WP & Supporting Documents	$1,966,213	$0	$638,543	32.48%	$2,604,756
04.03.04	**04**	**----Supporting Documents**	**$56,929**	**$0**	**$22,000**	**38.65%**	**$78,929**
04.03.05	**04**	**----SAR/TSR Addendum**	**$1,343,255**	**$0**	**$335,814**	**25.00%**	**$1,679,069**
04.03.06	**04**	**----Subcontractor DWEP (BBWI Review Costs)**	**$9,141**	**$0**	**$2,285**	**25.00%**	**$11,426**
04.03.07		**----IWCP**	**$556,889**	**$0**	**$278,444**	**50.00%**	**$835,333**
04.03.07.01	04	------IWCP for Site Preparations	$189,174	$0	$94,587	50.00%	$283,761
04.03.07.02	04	------IWCP for Tank Contents Removal and Treatment	$178,541	$0	$89,270	50.00%	$267,811
04.03.07.03	05	------IWCP for Tank and Ancillary Piping and Equipment	$189,174	$0	$94,587	50.00%	$283,761
04.04	05	--Readiness Assessment	$670,291	$0	$167,573	25.00%	$837,864
04.05	05	--RCRA Closure Plan	$179,272	$0	$44,818	25.00%	$224,090
04.06	06	--Project Closeout	$17,238	$0	$4,309	25.00%	$21,547
05		Remedial Action	$9,867,959	$0	$4,719,732	47.83%	$14,587,691
05.01	03	--Early Site Prep	$50,477	$0	$12,619	25.00%	$63,096
05.02		--Early Remediation Actions	$648,951	$0	$162,238	25.00%	$811,189
5.02.01		**----Tank Volume Monitoring**	**$227,315**	**$0**	**$56,829**	**25.00%**	**$284,144**
5.02.01.01	03	------Tank Level Monitoring During FY-03	$90,926	$0	$22,732	25.00%	$113,658
5.02.01.02	04	------Tank Level Monitoring During FY-04	$90,926	$0	$22,732	25.00%	$113,658
5.02.01.03	05	------Tank Level Monitoring During FY-05	$45,463	$0	$11,366	25.00%	$56,829

Project Summary Report

Project Name: ***WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate***
IN Situ Chemical Oxidation & Grouting
Project Location: ***INEEL - TAN***
Estimate Number: ***6305 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/R. D. R/R. D. A.***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
5.02.02	**03**	**----Current Waste Management**	**$69,269**	**$0**	**$17,317**	**25.00%**	**$86,586**
5.02.03	**03**	**----Current Waste Disposition**	**$347,505**	**$0**	**$86,876**	**25.00%**	**$434,381**
5.02.04		**----Institutional Controls, Interface and Maintenance**	**$4,862**	**$0**	**$1,216**	**25.00%**	**$6,078**
5.02.04.01	03	------IC Control During FY-03	$1,945	$0	$486	25.00%	$2,431
5.02.04.02	04	------IC Control During FY-04	$1,945	$0	$486	25.00%	$2,431
5.02.04.03	05	------IC Control During FY-05	$972	$0	$243	25.00%	$1,215
05.03		--Remedial Action PM	$2,916,831	$0	$729,208	25.00%	$3,646,038
05.03.01	**05**	**----Remedial Action Pm During FY-05**	**$1,458,415**	**$0**	**$364,604**	**25.00%**	**$1,823,019**
05.03.02	**06**	**----Remedial Action Pm During FY-06**	**$1,458,415**	**$0**	**$364,604**	**25.00%**	**$1,823,019**
05.04	05	--In Situ Chemical Oxidation	$6,251,701	$0	$3,815,667	61.03%	$10,067,369
06		FFA/CO Managment & Oversight 10/1/03 through 10/1/08	$4,213,604	$0	$1,053,401	25.00%	$5,267,004
06.01		--FFA/CO Management & Oversight	$3,994,436	$0	$998,609	25.00%	$4,993,045
06.01.01	**03**	**----Project Management & Support for FY-03**	**$836,436**	**$0**	**$209,109**	**25.00%**	**$1,045,545**
06.01.02	**04**	**----Project Management & Support for FY-04**	**$628,000**	**$0**	**$157,000**	**25.00%**	**$785,000**
06.01.03	**05**	**----Project Management & Support for FY-05**	**$1,025,000**	**$0**	**$256,250**	**25.00%**	**$1,281,250**
06.01.04	**06**	**----Project Management & Support for FY-06**	**$1,025,000**	**$0**	**$256,250**	**25.00%**	**$1,281,250**
06.01.05	**07**	**----Project Management & Support for FY-07**	**$480,000**	**$0**	**$120,000**	**25.00%**	**$600,000**
06.02	03	--Technology Evaluation, Proposed Plan & ROD Amendment	$219,168	$0	$54,792	25.00%	$273,959
07	05	Material Handling Fees	$87,028	$0	$21,757	25.00%	$108,785
Total		In Situ Chemical Oxidation & Grouting WAG 1 V-Tanks Life Cycle Estimate	$25,631,770	$0	$7,311,344	28.52%	$32,943,114

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Net Present Value for Estimating Services File #6305 - Wag 1 V-Tanks In Situ Chemical Oxidation and Grouting

A discount rate of 7%, as provided by the Office of Management and Budgets in Circular A-94, has been used. Per that circular, 7% yearly discount factors are to be used for the first 30 years with the 30 year factor used for all years greater than 30. The 7% discount rate assumes a 2.1% escalation rate. Because this escalation is accounted for in the discount rate, escalation values were removed from the cost estimate prior to use in this table.

Fiscal Year	Counting year	Expected Yearly Capital Cost	Expected Yearly O&M Cost	Expected Yearly Combined Capital and O&M Cost	Discount Factors for Mid Year 7%	Present Value of Capital Costs	Present Value of O&M Costs	Combined Capital and O&M Net Present Value
Totals		**$ 32,943,115**	**1,514,000**	**$ 34,457,115**		**$ 29,201,456**	**$ 275,300**	**$ 29,476,756**
pre FY 2003	0	$ 5,985,323		$ 5,985,323	1	$ 5,985,323		$ 5,985,323
FY 2003	1	$ 2,923,992		$ 2,923,992	0.9667	$ 2,826,623		$ 2,826,623
FY 2004	2	$ 5,623,802		$ 5,623,802	0.9035	$ 5,081,105		$ 5,081,105
FY 2005	3	$ 14,684,182		$ 14,684,182	0.8444	$ 12,399,323		$ 12,399,323
FY 2006	4	$ 3,125,816		$ 3,125,816	0.7891	$ 2,466,581		$ 2,466,581
FY 2007	5	$ 600,000	14,000	$ 614,000	0.7375	$ 442,500	$ 10,325	$ 452,825
FY 2012	10		75,000	$ 75,000	0.5258		$ 39,435	$ 39,435
FY 2017	15		75,000	$ 75,000	0.3749		$ 28,118	$ 28,118
FY 2022	20		75,000	$ 75,000	0.2673		$ 20,048	$ 20,048
FY 2027	25		75,000	$ 75,000	0.1906		$ 14,295	$ 14,295
FY 2032	30		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2037	35		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2042	40		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2047	45		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2052	50		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2057	55		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2062	60		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2067	65		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2072	70		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2077	75		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2082	80		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2087	85		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2092	90		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2097	95		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2102	100		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2107	105		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193

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Project Summary Report

Project Name: ***WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate***
Ex Situ Chemical Oxidation & Grouting
Project Location: ***INEEL - TAN***
Estimate Number: ***6304 (Wallace 2002)***

Client: ***J. J. Jessmore***
Prepared By: ***B. W. Wallace/R. D. R./R. D. A.***
Estimate Type: ***Project Support***

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
01	01	Historical Costs Beginning @ ROD Acceptance &Ending 9/30/02	$5,985,323	$0	$0	0.00%	$5,985,323
03	03	Technology Evaluation, Proposed Plan and ROD Amendment	$723,469	$0	$180,867	25.00%	$904,336
04		Remedial Design & Supporting Documentation	$4,754,387	$0	$1,335,065	28.08%	$6,089,452
04.01	04	--Remedial Design PM	$1,451,410	$0	$362,853	25.00%	$1,814,263
04.02	04	--Group 2 RD/RA WP Addendum for Early RA	$469,963	$0	$117,491	25.00%	$587,454
04.03		--New Group 2 RD/RA WP & Supporting Documents	$1,966,213	$0	$638,022	32.45%	$2,604,235
04.03.04	**04**	**----Supporting Documents**	**$56,929**	**$0**	**$21,479**	**37.73%**	**$78,407**
04.03.05	**04**	**----SAR/TSR Addendum**	**$1,343,255**	**$0**	**$335,814**	**25.00%**	**$1,679,069**
04.03.06	**04**	**----Subcontractor DWEP (BBWI Review Costs)**	**$9,141**	**$0**	**$2,285**	**25.00%**	**$11,426**
04.03.07		**----IWCP**	**$556,889**	**$0**	**$278,444**	**50.00%**	**$835,333**
04.03.07.01	04	------IWCP for Site Preparations	$189,174	$0	$94,587	50.00%	$283,761
04.03.07.02	04	------IWCP for Tank Contents Removal and Treatment	$178,541	$0	$89,270	50.00%	$267,811
04.03.07.03	05	------IWCP for Tank and Ancillary Piping and Equipment	$189,174	$0	$94,587	50.00%	$283,761
04.04	05	--Readiness Assessment	$670,291	$0	$167,573	25.00%	$837,864
04.05	05	--RCRA Closure Plan	$179,272	$0	$44,818	25.00%	$224,090
04.06	06	--Project Closeout	$17,238	$0	$4,309	25.00%	$21,547
05		Remedial Action	$10,050,903	$0	$4,447,664	44.25%	$14,498,567
05.01	03	--Early Site Prep	$50,477	$0	$12,619	25.00%	$63,096
05.02		--Early Remediation Actions	$648,951	$0	$162,238	25.00%	$811,189
5.02.01		**----Tank Volume Monitoring**	**$227,315**	**$0**	**$56,829**	**25.00%**	**$284,144**
5.02.01.01	03	------Tank Level Monitoring During FY-03	$90,926	$0	$22,732	25.00%	$113,658
5.02.01.02	04	------Tank Level Monitoring During FY-04	$90,926	$0	$22,732	25.00%	$113,658
5.02.01.03	05	------Tank Level Monitoring During FY-05	$45,463	$0	$11,366	25.00%	$56,829

Project Summary Report

Project Name: *WAG 1 V-Tanks Tech Evaluation Life Cycle Estimate*
Ex Situ Chemical Oxidation & Grouting
Project Location: *INEEL - TAN*
Estimate Number: *6304 (Wallace 2002)*

Client: *J. J. Jessmore*
Prepared By: *B. W. Wallace/R. D. R./R. D. A.*
Estimate Type: *Project Support*

Level	Group	Description	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
5.02.02	03	----Current Waste Management	$69,269	$0	$17,317	25.00%	$86,586
5.02.03	03	----Current Waste Disposition	$347,505	$0	$86,876	25.00%	$434,381
5.02.04		----Institutional Controls, Interface and Maintenance	$4,862	$0	$1,216	25.00%	$6,078
5.02.04.01	03	------IC Control During FY-03	$1,945	$0	$486	25.00%	$2,431
5.02.04.02	04	------IC Control During FY-04	$1,945	$0	$486	25.00%	$2,431
5.02.04.03	05	------IC Control During FY-05	$972	$0	$243	25.00%	$1,215
05.03		--Remedial Action PM	$2,916,831	$0	$729,208	25.00%	$3,646,038
05.03.01	05	----Remedial Action Pm During FY-05	$1,458,415	$0	$364,604	25.00%	$1,823,019
05.03.02	06	----Remedial Action Pm During FY-06	$1,458,415	$0	$364,604	25.00%	$1,823,019
05.04	05	--Remedial Action	$6,434,645	$0	$3,543,600	55.07%	$9,978,244
06		FFA/CO Managment & Oversight 10/1/03 through 10/1/08	$4,213,604	$0	$1,053,401	25.00%	$5,267,004
06.01		--FFA/CO Management & Oversight	$3,994,436	$0	$998,609	25.00%	$4,993,045
06.01.01	03	----Project Management & Support for FY-03	$836,436	$0	$209,109	25.00%	$1,045,545
06.01.02	04	----Project Management & Support for FY-04	$628,000	$0	$157,000	25.00%	$785,000
06.01.03	05	----Project Management & Support for FY-05	$1,025,000	$0	$256,250	25.00%	$1,281,250
06.01.04	06	----Project Management & Support for FY-06	$1,025,000	$0	$256,250	25.00%	$1,281,250
06.01.05	07	----Project Management & Support for FY-07	$480,000	$0	$120,000	25.00%	$600,000
06.02	03	--Technology Evaluation, Proposed Plan & ROD Amendment	$219,168	$0	$54,792	25.00%	$273,959
07	05	Material Handling Fees	$87,028	$0	$21,757	25.00%	$108,785
Total		Ex Situ Chemical Oxidation & Grouting WAG 1 V-Tanks Life Cycle Estimate	$25,814,713	$0	$7,038,755	27.27%	$32,853,468

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Net Present Value for Estimating Services File #6304 - Wag 1 V-Tanks Ex Situ Chemical Oxidation and Grouting

A discount rate of 7%, as provided by the Office of Management and Budgets in Circular A-94, has been used. Per that circular, 7% yearly discount factors are to be used for the first 30 years with the 30 year factor used for all years greater than 30. The 7% discount rate assumes a 2.1% escalation rate. Because this escalation is accounted for in the discount rate, escalation values were removed from the cost estimate prior to use in this table.

Fiscal Year	Counting year	Expected Yearly Capital Cost	Expected Yearly O&M Cost	Expected Yearly Combined Capital and O&M Cost	Discount Factors for Mid Year 7%	Present Value of Capital Costs	Present Value of O&M Costs	Combined Capital and O&M Net Present Value
Totals		**$ 32,853,468**	**1,514,000**	**$ 34,367,468**		**$ 29,125,727**	**$ 275,300**	**$ 29,401,027**
pre FY 2003	0	$ 5,985,323		$ 5,985,323	1	$ 5,985,323		$ 5,985,323
FY 2003	1	$ 2,923,992		$ 2,923,992	0.9667	$ 2,826,623		$ 2,826,623
FY 2004	2	$ 5,623,280		$ 5,623,280	0.9035	$ 5,080,633		$ 5,080,633
FY 2005	3	$ 14,595,057		$ 14,595,057	0.8444	$ 12,324,066		$ 12,324,066
FY 2006	4	$ 3,125,816		$ 3,125,816	0.7891	$ 2,466,581		$ 2,466,581
FY 2007	5	$ 600,000	14,000	$ 614,000	0.7375	$ 442,500	$ 10,325	$ 452,825
FY 2012	10		75,000	$ 75,000	0.5258		$ 39,435	$ 39,435
FY 2017	15		75,000	$ 75,000	0.3749		$ 28,118	$ 28,118
FY 2022	20		75,000	$ 75,000	0.2673		$ 20,048	$ 20,048
FY 2027	25		75,000	$ 75,000	0.1906		$ 14,295	$ 14,295
FY 2032	30		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2037	35		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2042	40		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2047	45		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2052	50		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2057	55		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2062	60		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2067	65		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2072	70		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2077	75		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2082	80		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2087	85		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2092	90		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2097	95		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2102	100		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193
FY 2107	105		75,000	$ 75,000	0.1359		$ 10,193	$ 10,193

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Appendix B

Criteria Weight Distribution

Value Function	State Variable Input	Input Range	Output Variable Label	Relative Weight within Category	Model Weight
2.1 Implementability:				**33.00%**	
Technical Feasibility			TFEAS	40.00%	13.20%
2.1.1.1 Ability to construct and operate	ACO	Number from 0 to 10	ACOV	34.85%	4.60%
2.1.1.2 Reliability of the alternative	MCR	Number (major components)	MCRV	34.85%	4.60%
2.1.1.3 Ease of additional remedial actions	EAR	Number from 0 to 10	EARV	15.15%	2.00%
2.1.1.4 Monitoring considerations	ER	Number from 0 to 10	ERV	15.15%	2.00%
Administrative Feasibility			ADFEAS	20.00%	6.60%
2.1.2 Administrative feasibility	AF	Number (regulatory waivers)	AFV	100.00%	6.60%
Availability of Services and Materials			AVSM	40.00%	13.20%
2.1.3.1a Availability of storage and disposal facilities	RDF	Number from 0 to 10	RDFV	69.70%	9.20%
2.1.3.1b Control factor	CF	Number from 0 to 10	CFV		NA
2.1.3.2 Availability of equipment and specialists	NES	Number from 0 to 10	NESV	30.30%	4.00%
2.2 Short-Term Effectiveness:				**25.00%**	
Time to Remediate			TTR	60.00%	15.10%
2.2.1a Waste treatment	REMT	Number (years)	REMTV	37.09%	5.60%
2.2.1b ROD completion	RODT	Number (years)	RODTV	62.91%	9.50%
Community Protection			CPT	15.0%	3.8%
2.2.2 Community protection	CP	Number from 0 to 10	CPV	100.00%	3.80%
Worker Protection			WPN	15.0%	3.8%
2.2.3a Worker protection	WP	Number from 0 to 7	WPV	100.00%	3.80%

Value Function	State Variable Input	Input Range	Output Variable Label	Relative Weight within Category	Model Weight
2.2.3b Worker protection correction factor	WCF	Number from 0 to 10	WCFV		NA
Environmental Impacts			EIV	10.0%	2.3%
2.2.4a Animal impact	AI	Number from 0 to 10	AIV	50.00%	1.15%
2.2.4b Plant impact	PI	Number from 0 to 10	PIV	50.00%	1.15%
2.3 Long-Term Effectiveness and Permanence:				**8.00%**	
Residual Risk			RRVN	50.0%	4.0%
2.3.1 Magnitude of residual risk	RR	Number from 0 to 10	RRV	100.00%	4.00%
Controls			CON	50.0%	4.0%
2.3.2 Adequacy and reliability of controls	ARC	Number from 0 to 10	ARCV	100.00%	4.00%
2.4 Reduction of Toxicity, Mobility, or Volume through Treatment:				**17.00%**	
Amount of hazardous material destroyed or treated			HDTV	49.7%	8.2%
2.4.1a Reduction of volume	VOL	Number (m^3)	VOLV	32.00%	2.65%
2.4.1b TRU concentration	TRU	Number (nCi/g)	TRUV	22.50%	1.85%
2.4.1c Cadmium concentration	CD	Number (mg/L)	CDV	7.58%	0.62%
2.4.1d Lead concentration	PB	Number (mg/L)	PBV	7.58%	0.62%
2.4.1e Mercury concentration	HG	Number (mg/L)	HGV	7.58%	0.62%
2.4.1f PCB concentration	PCB	Number (mg/Kg)	PCBV	7.58%	0.62%
2.4.1g PCE/TCE	PTCE	Number (mg/Kg)	PTCEV	7.58%	0.62%
2.4.1h BEHP concentration	BEHP	Number (mg/Kg)	BEHPV	7.58%	0.62%

Value Function	State Variable Input	Input Range	Output Variable Label	Relative Weight within Category	Model Weight
Amount of Principle Threat Treated to Reduce Toxicity, Mobility, or Volume			PTVN	30.0%	5.1%
2.4.2 Principle threat Cs-137	PT	Number (pCi/g Cs-137)	PTV	100.00%	5.10%
Irreversibility of Treatment of COCs			ITCOC	15.0%	2.6%
2.4.3 Irreversibility	IRR	Number (years)	IRRV	100.00%	2.60%
Treatment Residuals			TRV	5.30%	0.9%
2.4.4 Secondary waste	SW	Number (m^3)	SWV	100.00%	0.90%
2.5 Cost:				**13.00%**	
Cost			CV	100.00%	13.00%
2.5 Life-cycle cost	COS	Number ($M)	COSV	100.00%	13.00%
2.6 Application to Other Waste Streams:				**4.00%**	
Other Applicability			OAV	100.00%	4.00%
2.6a Applicability to ARA-16 waste	ARA	Number from 0 to 10	ARAV	33.33%	1.33%
2.6b Applicability to PM-2A waste	PM	Number from 0 to 10	PMV	33.33%	1.33%
2.6c Applicability to SDW waste	SDW	Number from 0 to 10	SDWV	33.33%	1.33%

Appendix C

Detailed Output from V-Tanks Decision Support Model

Table C-1. Detailed model output for in situ vitrification.

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
Alternative 1.a—Implementability:									2.29
4.1 Implementability							6.93	33.00%	
4.1.1Technical Feasibility					5.788	40.00%	2.31	13.20%	
4.1.1.1 Ability to construct and operate	7	7	34.85%	2.439				4.60%	
4.1.1.2 Reliability of the alternative	12	5	34.85%	1.742				4.60%	
4.1.1.3 Ease of additional remedial actions	4	6.4	15.15%	0.970				2.00%	
4.1.1.4 Monitoring considerations	4	4.2	15.15%	0.636				2.00%	
4.1.2 Administrative feasibility					6	20.00%	1.20	6.60%	
4.1.2 Administrative feasibility	2	6.0	100.00%	6.0				6.60%	
4.1.3 Availability of services and materials					8.545	40.00%	3.42	13.20%	
4.1.3.1a Availability of storage and disposal facilities	10	9	69.70%	6.273				9.20%	
4.1.3.1b Control factor	7.5							NA	
4.1.3.2 Availability of equipment and specialists	7.5	7.5	30.30%	2.273				4.00%	
Alternative 1.a—Short-Term Effectiveness:									1.58
4.2 Short-term effectiveness:							6.33	25.00%	
4.2.1 Time to remediate					6.223	60.00%	3.73	15.10%	
4.2.1a Waste treatment	2	6.66	37.09%	2.448				5.60%	
4.2.1b ROD completion	3	6	62.91%	3.775				9.50%	
4.2.2 Community protection					8.00	15.00%	1.20	3.80%	
4.2.2 Community protection	8	8	100.00%	8.000				3.80%	

Table C-1. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.2.3 Worker protection					2.67	15.00%	0.40	3.80%	
4.2.3a Worker protection	5	2.667	100.00%	2.667				3.80%	
4.2.3b Worker protection correction factor	5							NA	
4.2.4 Environmental impacts					10.0	10.00%	1.0	2.30%	
4.2.4a Animal impact	10	10	50.00%	0.000				1.15%	
4.2.4b Plant impact	10	10	50.00%	0.000				1.15%	
Alternative 1.a—Long-Term Effectiveness and Permanence:									0.80
4.3 Long-term effectiveness and permanence							10.00	8.00%	
Residual risk					10.00	50.00%	5.00	4.00%	
4.3.1 Magnitude of residual risk	10	10	100.00%	10.000				4.00%	
Controls					10.00	50.00%	5.00	4.00%	
4.3.2 Adequacy and reliability of controls	10	10	100.00%	10.000				4.00%	
Alternative 1.a—Reduction of TMV:									1.325
4.4 Reduction of toxicity, mobility, or volume through treatment							7.794	17.00%	
4.4.1 Amount of hazardous material destroyed or treated					9.465	49.7%	4.70	8.45%	
4.4.1a Reduction of volume	2250	8.335	32.0%	2.541				2.70%	
4.4.1b TRU concentration	Lognormal (0.449,1)	10	22.5%	2.317				1.90%	
4.4.1c Cadmium concentration	0.00E+00	10	7.58%	0.772				0.64%	

Table C-1. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.4.1d Lead concentration	Lognormal (1.440e-005,1)	10	7.58%	0.772				0.64%	
4.4.1e Mercury concentration	0.00E+00	10	7.58%	0.772				0.64%	
4.4.1f PCB concentration	0.00E+00	10	7.58%	0.772				0.64%	
4.4.1g TCE	0.00E+00	10	7.58%	0.772				0.64%	
4.4.1h BEHP	0.00E+00	10	7.58%	0.772				0.64%	
4.4.2 Amount of principal threat treated to reduce toxicity, mobility, or volume					5.00	30.00%	1.50	5.10%	
4.4.2 Principle threat Cs-137	2.33	5	100.00%	5.000				5.10%	
4.4.3 Irreversibility of treatment of CFTs					10.00	15.00%	1.50	2.60%	
4.4.3 Irreversibility	Uniform (1.000e+004, 1.000e+005)	10	100.00%	10.000				2.60%	
4.4.4 Treatment residuals					1.7	5.3%	0.09	0.9%	
4.4.4 Secondary waste	123	1.7	100.00%	1.7				0.9%	
Alternative 1.a—Cost									0.526
4.5 Cost							4.049	13.00%	
4.5Cost					4.049	100.00%	4.049	13.00%	
4.5 Life-cycle cost	Triangular (2.47e+7, 3.30e+7, 3.79e+7)	4.049	100.00%	4.049				13.00%	
Alternative 1.a—Other Waste Streams:									0.40
4.6 Application to other waste streams							10.00	4.00%	
Other applicability					10.00	100.00%	10.00	4.00%	
4.6a Applicability to ARA-16 waste	10	10	33.33%	3.333				1.33%	

Table C-1. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.6b Applicability to PM-2A waste	10	10	33.33%	3.333				1.33%	
4.6c Applicability to investigation-derived waste	10	10	33.33%	3.333				1.33%	
Total Score for Alternative 1.a									6.9

Table C-2. Detailed model output for ex situ vitrification.

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
Alternative 1.b—Implementability:									2.23
4.1 Implementability							6.76	33.00%	
4.1.1Technical feasibility					5.367	40.00%	2.15	13.20%	
4.1.1.1 Ability to construct and operate	6	6	34.85%	2.091				4.60%	
4.1.1.2 Reliability of the alternative	13	3.75	34.85%	1.307				4.60%	
4.1.1.3 Ease of additional remedial actions	5	8	15.15%	1.212				2.00%	
4.1.1.4 Monitoring considerations	5	5	15.15%	0.758				2.00%	
4.1.2 Administrative feasibility					6.0	20.00%	1.20	6.60%	
4.1.2 Administrative feasibility	2	6	100.00%	6.000				6.60%	
4.1.3 Availability of services and materials					8.545	40.00%	3.42	13.20%	
4.1.3.1a Availability of storage and disposal facilities	10	9	69.70%	6.273				9.20%	
4.1.3.1b Control factor	7.5							NA	
4.1.3.2 Availability of equipment and specialists	7.5	7.5	30.30%	2.273				4.00%	
Alternative 1.b—Short-Term Effectiveness:									1.58
4.2 Short-term effectiveness:							6.314	25.00%	
4.2.1 Time to remediate					6.223	60.00%	3.73	15.10%	
4.2.1a Waste treatment	2	6.66	37.09%	2.470				5.60%	
4.2.1b ROD completion	3	6	62.91%	3.775				9.50%	
4.2.2 Community protection					8	15.00%	1.20	3.80%	
4.2.2 Community protection	8	8	100.00%	8.000				3.80%	
4.2.3 Worker protection					2.533	15.00%	0.38	3.80%	
4.2.3a Worker protection	5	2.533	100.00%	2.533				3.80%	
4.2.3b Worker protection correction factor	6							NA	

Table C-2. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.2.4 Environmental impacts					10	10.00%	1.0	2.30%	
4.2.4a Animal impact	10	10	50.00%	5.0				1.15%	
4.2.4b Plant impact	10	10	50.00%	5.0				1.15%	
Alternative 1.b—Long-Term Effectiveness and Permanence:									0.80
4.3 Long-term effectiveness and permanence							10.00	8.00%	
Residual risk					10	50.00%	5.00	4.00%	
4.3.1 Magnitude of residual risk	10	10	100.00%	10.000				4.00%	
Controls					10	50.00%	5.00	4.00%	
4.3.2 Adequacy and reliability of controls	10	10	100.00%	10.000				4.00%	
Alternative 1.b—Reduction of TMV:									1.2
4.4 Reduction of toxicity, mobility, or volume through treatment							7.042	17.00%	
4.4.1 Amount of hazardous material destroyed or treated					7.579	49.7%	3.77	8.45%	
4.4.1a Reduction of volume	2427	2.441	32.0%	0.781				2.7%	
4.4.1b TRU concentration	Lognormal (6.38,1)	10	22.5%	2.250				1.90%	
4.4.1c Cadmium concentration	0.00E+00	10	7.58%	0.758				0.64%	
4.4.1d Lead concentration	Lognormal (2.050e-004,1)	10	7.58%	0.758				0.64%	
4.4.1e Mercury concentration	0.00E+00	10	7.58%	0.758				0.64%	
4.4.1f PCB concentration	0.00E+00	10	7.58%	0.758				0.64%	
4.4.1g TCE	0.00E+00	10	7.58%	0.758				0.64%	
4.4.1h BEHP	0.00E+00	10	7.58%	0.758				0.64%	

Table C-2. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.4.2 Amount of principal threat treated to reduce toxicity, mobility, or volume					5	30.00%	1.50	5.10%	
4.4.2 Principle threat Cs-137	2.33	5	100.00%	5.000				5.10%	
4.4.3 Irreversibility of treatment of CFTs					10	15.00%	1.50	2.60%	
4.4.3 Irreversibility	Uniform (1.000e+004, 1.000e+005)	10	100.00%	10.000				2.60%	
4.4.4 Treatment residuals					5.2	5.3%	0.28	0.9%	
4.4.4 Secondary waste	88	5.20	100.00%	5.20				0.9%	
Alternative 1.b—Cost:									0.55
4.5 Cost							4.211	13.00%	
Cost					4.211	100.00%	4.211	13.00%	
4.5 Life-cycle cost	Triangular (2.45e+7, 3.27e+7, 3.76e+7)	4.211	100.00%	4.211				13.00%	
Alternative 1.b—Other Waste Streams:									0.40
4.6 Application to other waste streams							10.00	4.00%	
Other applicability					10	100.00%	10.00	4.00%	
4.6a Applicability to ARA-16 waste	10	10	33.33%	3.333				1.33%	
4.6b Applicability to PM-2A waste	10	10	33.33%	3.333				1.33%	
4.6c Applicability to investigation-derived waste	10	10	33.33%	3.333				1.33%	
Total Score for Alternative 1.b									6.8

Table C-3. Detailed model output for thermal desorption on/off-Site.

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
Alternative 2.a—Implementability:									2.52
4.1 Implementability							7.63	33.00%	
4.1.1Technical feasibility					6.98	40.00%	2.79	13.20%	
4.1.1.1 Ability to construct and operate	6	6	34.85%	2.091				4.60%	
4.1.1.2 Reliability of the alternative	10	7.5	34.85%	2.614				4.60%	
4.1.1.3 Ease of additional remedial actions	6	8.4	15.15%	1.273				2.00%	
4.1.1.4 Monitoring considerations	7	6.6	15.15%	1				2.00%	
4.1.2 Administrative feasibility					8.5	20.00%	1.7	6.60%	
4.1.2 Administrative feasibility	0.75	8.5	100.00%	8.5				6.60%	
4.1.3 Availability of services and materials					7.85	40.00%	3.14	13.20%	
4.1.3.1a Availability of storage and disposal facilities	10	8	69.70%	5.576				9.20%	
4.1.3.1b Control factor	5							NA	
4.1.3.2 Availability of equipment and specialists	7.5	7.5	30.30%	2.273				4.00%	
Alternative 2.a—Short-Term Effectiveness:									1.55
4.2 Short-term effectiveness:							6.204	25.00%	
4.2.1 Time to remediate					6.22	60.00%	3.73	15.10%	
4.2.1a Waste treatment	2	6.6	37.09%	2.45				5.60%	
4.2.1b ROD completion	3	6	62.91%	3.775				9.50%	
4.2.2 Community protection					5.00	15.00%	0.75	3.80%	
4.2.2 Community protection	5	5	100.00%	5				3.80%	

Table C-3. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.2.3 Worker protection					4.80	15.00%	0.72	3.80%	
4.2.3a Worker protection	4	4.8	100.00%	4.8				3.80%	
4.2.3b Worker protection correction factor	7							NA	
4.2.4 Environmental impacts					10.00	10.00%	1.0	2.30%	
4.2.4a Animal impact	10	10	50.00%	5.0				1.15%	
4.2.4b Plant impact	10	10	50.00%	5.0				1.15%	
Alternative 2.a—Long-Term Effectiveness and Permanence:									0.80
4.3 Long-term effectiveness and permanence							10.00	8.00%	
Residual risk					10.00	50.00%	5.00	4.00%	
4.3.1 Magnitude of residual risk	10	10	100.00%	10				4.00%	
Controls					10.00	50.00%	5.00	4.00%	
4.3.2 Adequacy and reliability of controls	10	10	100.00%	10				4.00%	
Alternative 2.a—Reduction of TMV:									1.00
4.4 Reduction of toxicity, mobility, or volume through treatment							5.887	17.00%	
4.4.1 Amount of hazardous material destroyed or treated					6.74	49.7%	3.35	8.45%	
4.4.1a Reduction of volume	2407	3.107	32.0%	0.994				2.7%	
4.4.1b TRU concentration	Lognormal (0.816,1)	10	22.5%	2.250				1.90%	
4.4.1c Cadmium concentration	Lognormal (0.0188,1)	3.836	7.58%	0.291				0.64%	
4.4.1d Lead concentration	Lognormal	2.284	7.58%	0.173				0.64%	

Table C-3. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
	(0.262,1)								
4.4.1e Mercury concentration	Lognormal (1.930e-004,1)	10	7.58%	0.0758				0.64%	
4.4.1f PCB concentration	Lognormal (3.440e-003,1)	10	7.58%	0.758				0.64%	
4.4.1g TCE	0.00E+00	10	7.58%	0.758				0.64%	
4.4.1h BEHP	0.00E+00	10	7.58%	0.758				0.64%	
4.4.2 Amount of principal threat treated to reduce toxicity, mobility, or volume					5.00	30.00%	1.50	5.10%	
4.4.2 Principle threat Cs-137	2.33	5	100.00%	5				5.10%	
4.4.3 Irreversibility of treatment of CFTs					6.67	15.00%	1.00	2.60%	
4.4.3 Irreversibility	1000	6.666	100.00%	6.666				2.60%	
4.4.4 Treatment residuals					0.7	5.3%	0.037	0.9%	
4.4.4 Secondary waste	133	0.7	100.00%	0.7				0.9%	
Alternative 2.a—Cost:									0.73
4.5 Cost							5.608	13.00%	
Cost					5.608	100.00%	5.608	13.00%	
4.5 Life-cycle cost	Triangular (2.27e+7, 3.03e+7, 3.48e+7)	5.608	100.00%	5.608				13.00%	
Alternative 2.a—Other Waste Streams:									0.31
4.6 Application to other waste streams							7.66	4.00%	
Other applicability					7.66	100.00%	7.66	4.00%	
4.6a Applicability to ARA-16 waste	8	8	33.33%	2.667				1.33%	
4.6b Applicability to PM-2A waste	10	10	33.33%	3.333				1.33%	

Table C-3. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.6c Applicability to investigation-derived waste	5	5	33.33%	1.667				1.33%	
Total Score for Alternative 2.a									6.9

Table C-4. Detailed model output for thermal desorption on-Site.

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
Alternative 2.b—Implementability:									2.49
4.1 Implementability							7.538	33.00%	
4.1.1Technical feasibility					6.602	40.00%	2.64	13.20%	
4.1.1.1 Ability to construct and operate	6	6	34.85%	2.091				4.60%	
4.1.1.2 Reliability of the alternative	11	6.25	34.85%	2.178				4.60%	
4.1.1.3 Ease of additional remedial actions	7	8.8	15.15%	1.333				2.00%	
4.1.1.4 Monitoring considerations	7	6.6	15.15%	1				2.00%	
4.1.2 Administrative feasibility					6.00	20.00%	1.20	6.60%	
4.1.2 Administrative feasibility	2	6.0	100.00%	6.0				6.60%	
4.1.3 Availability of services and materials					9.242	40.00%	3.70	13.20%	
4.1.3.1a Availability of storage and disposal facilities	10	10	69.70%	6.970				9.20%	
4.1.3.1b Control factor	10							NA	
4.1.3.2 Availability of equipment and specialists	7.5	7.5	30.30%	2.273				4.00%	
Alternative 2.b—Short-Term Effectiveness:									1.74
4.2 Short-term effectiveness:							6.954	25.00%	
4.2.1 Time to remediate					6.223	60.00%	3.73	15.10%	
4.2.1a Waste treatment	2	6.66	37.09%	2.470				5.60%	
4.2.1b ROD completion	3	6	62.91%	3.775				9.50%	
4.2.2 Community protection					10.0	15.00%	1.5	3.80%	
4.2.2 Community protection	10	10	100.00%	10				3.80%	

Table C-4. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.2.3 Worker protection					4.80	15.00%	0.72	3.80%	
4.2.3a Worker protection	4	4.8	100.00%	4.8				3.80%	
4.2.3b Worker protection correction factor	7							NA	
4.2.4 Environmental impacts					10.00	10.00%	1.00	2.30%	
4.2.4a Animal impact	10	10	50.00%	5.0				1.15%	
4.2.4b Plant impact	10	10	50.00%	5.0				1.15%	
Alternative 2.b—Long-Term Effectiveness and Permanence:									0.80
4.3 Long-term effectiveness and permanence							10.00	8.00%	
Residual risk					10.00	50.00%	5.00	4.00%	
4.3.1 Magnitude of residual risk	10	10	100.00%	10				4.00%	
Controls					10.00	50.00%	5.00	4.00%	
4.3.2 Adequacy and reliability of controls	10	10	100.00%	10				4.00%	
Alternative 2.b—Reduction of TMV:									1.02
4.4 Reduction of toxicity, mobility, or volume through treatment							6.009	17.00%	
4.4.1 Amount of hazardous material destroyed or treated					6.74	49.7%	3.35	8.45%	
4.4.1a Reduction of volume	2407	3.107	32.0%	0.994				2.70%	
4.4.1b TRU concentration	Lognormal (0.816,1)	10	22.5%	2.250				1.90%	
4.4.1c Cadmium concentration	Lognormal (0.0188,1)	3.836	7.58%	2.907				0.64%	

Table C-4. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.4.1d Lead concentration	Lognormal (0.262,1)	2.284	7.58%	0.173				0.64%	
4.4.1e Mercury concentration	Lognormal (1.930e-004,1)	10	7.58%	0.758				0.64%	
4.4.1f PCB concentration	Lognormal (3.440e-003,1)	10	7.58%	0.758				0.64%	
4.4.1g TCE	0.00E+00	10	7.58%	0.758				0.64%	
4.4.1h BEHP	0.00E+00	10	7.58%	0.758				0.64%	
4.4.2 Amount of principal threat treated to reduce toxicity, mobility, or volume					5.00	30.00%	1.50	5.10%	
4.4.2 Principle threat Cs-137	2.33	5	100.00%	5				5.10%	
4.4.3 Irreversibility of treatment of CFTs					6.67	15.00%	1.00	2.60%	
4.4.3 Irreversibility	1000	6.666	100.00%	6.666				2.60%	
4.4.4 Treatment residuals					3.00	5.30%	0.16	0.9%	
4.4.4 Secondary waste	110	3.00	100.00%	3.00				0.9%	
Alternative 2.b—Cost:									0.723
4.5 Cost							5.592	13.00%	
Cost					5.592	100.00%	5.592	13.00%	
4.5 Life-cycle cost	Triangular (2.27e+7, 3.03e+7, 3.49e+7)	5.592	100.00%	5.592				13.00%	
Alternative 2.b—Other Waste Streams:									0.31
4.6 Application to other waste streams							7.66	4.00%	
Other applicability					7.67	100.00%	7.66	4.00%	
4.6a Applicability to ARA-16 waste	8	8	33.33%	2.667				1.33%	

Table C-4. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.6b Applicability to PM-2A waste	10	10	33.33%	3.333				1.33%	
4.6c Applicability to investigation-derived waste	5	5	33.33%	1.667				1.33%	
Total Score for Alternative 2.b									7.1

Table C-5. Detailed model output for thermal desorption off-Site.

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
Alternative 2.c—Implementability:									1.59
4.1 Implementability							4.814	33.00%	
4.1.1Technical feasibility					5.90	40.00%	2.36	13.20%	
4.1.1.1 Ability to construct and operate	Uniform (4,5)	4.5	34.85%	1.568				4.60%	
4.1.1.2 Reliability of the alternative	11	6.25	34.85%	2.178				4.60%	
4.1.1.3 Ease of additional remedial actions	6	8.4	15.15%	1.273				2.00%	
4.1.1.4 Monitoring considerations	6	5.8	15.15%	0.879				2.00%	
4.1.2 Administrative feasibility					5.50	20.00%	1.10	6.60%	
4.1.2 Administrative feasibility	2.25	5.5	100.00%	5.500				6.60%	
4.1.3 Availability of services and materials					3.39	40.00%	1.35	13.20%	
4.1.3.1a Availability of storage and disposal facilities	3.75	2.25	69.70%	1.568				9.20%	
4.1.3.1b Control factor	0							NA	
4.1.3.2 Availability of equipment and specialists	6	6	30.30%	1.818				4.00%	
Alternative 2.c—Short-Term Effectiveness:									1.03
4.2 Short-term effectiveness							4.124	25.00%	
4.2.1 Time to remediate					3.706	60.00%	2.22	15.10%	
4.2.1a Waste treatment	2	6.66	37.09%	2.470				5.60%	
4.2.1b ROD completion	5	2	62.91%	1.258				9.50%	
4.2.2 Community protection					2.00	15.00%	0.30	3.80%	

Table C-5. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.2.2 Community protection	2	2	100.00%	2				3.80%	
4.2.3 Worker protection					4.00	15.00%	0.60	3.80%	
4.2.3a Worker protection	4	4	100.00%	4				3.80%	
4.2.3b Worker protection correction factor	10							NA	
4.2.4 Environmental impacts					10.00	10.00%	1.00	2.30%	
4.2.4a Animal impact	10	10	50.00%	5.0				1.15%	
4.2.4b Plant impact	10	10	50.00%	5.0				1.15%	
Alternative 2.c—Long-Term Effectiveness and Permanence:									0.80
4.3 Long-term effectiveness and permanence							10.00	8.00%	
Residual risk					10.00	50.00%	5.00	4.00%	
4.3.1 Magnitude of residual risk	10	10	100.00%	10				4.00%	
Controls					10.00	50.00%	5.00	4.00%	
4.3.2 Adequacy and reliability of controls	10	10	100.00%	10				4.00%	
Alternative 2.c—Reduction of TMV:									1.05
4.4 Reduction of toxicity, mobility, or volume through treatment							6.188	17.00%	
4.4.1 Amount of hazardous material destroyed or treated					6.516	49.7%	3.24	8.45%	
4.4.1a Reduction of volume	2397	3.44	32.0%	1.101				2.70%	
4.4.1b TRU concentration	Lognormal (70.9,1)	8.323	22.5%	1.873				1.90%	
4.4.1c Cadmium concentration	Lognormal (0.0163,1)	4.146	7.58%	0.314				0.64%	
4.4.1d Lead concentration	Lognormal (2.270e-001,1)	2.595	7.58%	0.197				0.64%	

Table C-5. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.4.1e Mercury concentration	Lognormal (1.680e-004,1)	10	7.58%	0.758				0.64%	
4.4.1f PCB concentration	Lognormal (3.070e-007,1)	10	7.58%	0.758				0.64%	
4.4.1g TCE	0.00E+00	10	7.58%	0.758				0.64%	
4.4.1h BEHP	0.00E+00	10	7.58%	0.758				0.64%	
4.4.2 Amount of principal threat treated to reduce toxicity, mobility, or volume					5.00	30.00%	1.50	5.10%	
4.4.2 Principle threat Cs-137	2.33	5	100.00%	5				5.10%	
4.4.3 Irreversibility of treatment of CFTs					8.02	15.00%	1.20	2.60%	
4.4.3 Irreversibility	Triangular (1000, 2000, 5000)	8.01	100.00%	8.01				2.60%	
4.4.4 Treatment residuals					4.67	5.3%	0.25	0.9%	
4.4.4 Secondary waste	93.3	4.17	100.00%	4.67				0.9%	
Alternative 2.c—Cost:									0.46
4.5 Cost							3.572	13.00%	
Cost					3.572	100.00%	3.572	13.00%	
4.5 Life-cycle cost	Triangular (2.53e+7, 3.38e+7, 3.89e+7)	3.572	100.00%	3.572				13.00%	
Alternative 2.c—Other Waste Streams:									0.31

Table C-5. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.6 Application to other waste streams							7.66	4.00%	
Other applicability					7.67	100.00%	7.66	4.00%	
4.6a Applicability to ARA-16 waste	8	8	33.33%	2.667				1.33%	
4.6b Applicability to PM-2A waste	10	10	33.33%	3.333				1.33%	
4.6c Applicability to investigation-derived waste	5	5	33.33%	1.667				1.33%	
Total Score for Alternative 2.c									5.2

Table C-6. Detailed model output for in situ chemical oxidation/reduction followed by stabilization.

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
Alternative 3.a—Implementability:									2.34
4.1 Implementability							7.106	33.00%	
4.1.1 Technical feasibility					6.924	40.00%	2.77		
4.1.1.1 Ability to construct and operate	3	3	34.85%	1.045				4.60%	
4.1.1.2 Reliability of the alternative	8	10	34.85%	3.485				4.60%	
4.1.1.3 Ease of additional remedial actions	7	8.8	15.15%	1.333				2.00%	
4.1.1.4 Monitoring considerations	7.5	7	15.15%	1.061				2.00%	
4.1.2 Administrative feasibility					5.5	20.00%	1.10	6.60%	
4.1.2 Administrative feasibility	2.25	5.5	100.00%	5.5				6.60%	
4.1.3 Availability of services and materials					8.09	40.00%	3.24	13.20%	
4.1.3.1a Availability of storage and disposal facilities	10	9	69.70%	6.273				9.20%	
4.1.3.1b Control factor	7.5							NA	
4.1.3.2 Availability of equipment and specialists	6	6	30.30%	1.818				4.00%	
Alternative 3.a—Short-Term Effectiveness:									1.81
4.2 Short-term effectiveness:							7.254	25.00%	
4.2.1 Time to remediate					6.223	60.00%	3.73	15.10%	
4.2.1a Waste treatment	2	6.66	37.09%	2.470				5.60%	
4.2.1b ROD completion	3	6	62.91%	3.775				9.50%	
4.2.2 Community protection					8.0	15.00%	1.2	3.80%	
4.2.2 Community protection	8	8	100.00%	8.0				3.80%	
4.2.3 Worker protection					8.80	15.00%	1.32	3.80%	

Table C-6. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.2.3a Worker protection	3	8.8	100.00%	8.8				3.80%	
4.2.3b Worker protection correction factor	3							NA	
4.2.4 Environmental impacts					10.00	10.00%	1.00	2.30%	
4.2.4a Animal impact	10	10	50.00%	5.0				1.15%	
4.2.4b Plant impact	10	10	50.00%	5.0				1.15%	
Alternative 3.a—Long-Term Effectiveness and Permanence:									0.80
4.3 Long-term effectiveness and permanence							10.00	8.00%	
Residual risk					10.00	50.00%	5.00	4.00%	
4.3.1 Magnitude of residual risk	10	10	100.00%	10				4.00%	
Controls					10.00	50.00%	5.00	4.00%	
4.3.2 Adequacy and reliability of controls	10	10	100.00%	10				4.00%	
Alternative 3.a—Reduction of TMV:									0.99
4.4 Reduction of toxicity, mobility, or volume through treatment							5.818	17.00%	
4.4.1 Amount of hazardous material destroyed or treated					5.247	49.7%	2.6	8.45%	
4.4.1a Reduction of volume	2462	1.275	32.0%	0.408				2.70%	
4.4.1b TRU concentration	Lognormal (2.18,1)	10	22.5%	2.250				1.90%	
4.4.1c Cadmium concentration	Lognormal (1.140e-004,1)	10	7.58%	0.758				0.64%	
4.4.1d Lead concentration	Lognormal (1.570e-003,1)	10	7.58%	0.758				0.64%	

Table C-6. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.4.1e Mercury concentration	Lognormal (1.330e-003,1)	6.37	7.58%	0.483				0.64%	
4.4.1f PCB concentration	Lognormal (3.33,1)	2.388	7.58%	0.181				0.64%	
4.4.1g TCE	Lognormal (0.7,1)	4.663	7.58%	0.353				0.64%	
4.4.1h BEHP	Lognormal (20,1)	0.7306	7.58%	0.055				0.64%	
4.4.2 Amount of principal threat treated to reduce toxicity, mobility, or volume					5.00	30.00%	1.50	5.10%	
4.4.2 Principle threat Cs-137	2.33	5	100.00%	5				5.10%	
4.4.3 Irreversibility of treatment of CFTs					8.02	15.00%	1.20	2.60%	
4.4.3 Irreversibility	Triangular (1000, 2000, 5000)	8.01	100.00%	8.01				2.60%	
4.4.4 Treatment residuals					9.6	5.3%	0.51	0.9%	
4.4.4 Secondary waste	44	9.1	100.00%	9.6				0.9%	
Alternative 3.a—Cost:									0.79
4.5 Cost							6.068	13.00%	
Cost					6.068	100.00%	6.068	13.00%	
4.5 Life-cycle cost	Triangular (2.21e+7, 2.95e+7, 3.39e+7)	6.068	100.00%	6.068				13.00%	
Alternative 3.a—Other Waste Streams:									0.23
4.6 Application to other waste streams							5.66	4.00%	
Other applicability					5.67	100.00%	5.66	4.00%	
4.6a Applicability to ARA-16 waste	8	8	33.33%	2.667				1.33%	

Table C-6. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.6b Applicability to PM-2A waste	7	7	33.33%	2.333				1.33%	
4.6c Applicability to investigation-derived waste	2	2	33.33%	0.667				1.33%	
Total Score for Alternative 3.a									6.98

Table C-7. Detailed model output for ex situ chemical oxidation/reduction followed by stabilization.

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
Alternative 3.b—Implementability:									2.52
4.1 Implementability							7.629	33.00%	
4.1.1Technical feasibility					7.43	40.00%	2.97	13.20%	
4.1.1.1 Ability to construct and operate	5	5	34.85%	1.742				4.60%	
4.1.1.2 Reliability of the alternative	9	8.75	34.85%	3.049				4.60%	
4.1.1.3 Ease of additional remedial actions	8	9.2	15.15%	1.394				2.00%	
4.1.1.4 Monitoring considerations	8.5	8.2	15.15%	1.242				2.00%	
4.1.2 Administrative feasibility					6.50	20.00%	1.30	6.60%	
4.1.2 Administrative feasibility	1.75	6.5	100.00%	6.5				6.60%	
4.1.3 Availability of services and materials					8.394	40.00%	3.36	13.20%	
4.1.3.1a Availability of storage and disposal facilities	10	9	69.70%	6.273				9.20%	
4.1.3.1b Control factor	7.5							NA	
4.1.3.2 Availability of equipment and specialists	7	7	30.30%	2.121				4.00%	
Alternative 3.b—Short-Term Effectiveness:									1.80
4.2 Short-term effectiveness:							7.194	25.00%	
4.2.1 Time to remediate					6.223	60.00%	3.73	15.10%	
4.2.1a Waste treatment	2	6.66	37.09%	2.470				5.60%	
4.2.1b ROD completion	3	6	62.91%	3.775				9.50%	
4.2.2 Community protection					8.00	15.00%	1.20	3.80%	
4.2.2 Community protection	8	8	100.00%	8.0				3.80%	

Table C-7. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.2.3 Worker protection					8.40	15.00%	1.26	3.80%	
4.2.3a Worker protection	3	8.4	100.00%	8.4				3.80%	
4.2.3b Worker protection correction factor	4							NA	
4.2.4 Environmental impacts					10	10.00%	1.00	2.30%	
4.2.4a Animal impact	10	10	50.00%	5.0				1.15%	
4.2.4b Plant impact	10	10	50.00%	5.0				1.15%	
Alternative 3.b—Long-Term Effectiveness and Permanence:									0.80
4.3 Long-term effectiveness and permanence							10.00	8.00%	
Residual risk					10	50.00%	5.00	4.00%	
4.3.1 Magnitude of residual risk	10	10	100.00%	10				4.00%	
Controls					10	50.00%	5.00	4.00%	
4.3.2 Adequacy and reliability of controls	10	10	100.00%	10				4.00%	
Alternative 7—Reduction of 3.b TMV:									0.97
4.4 Reduction of toxicity, mobility, or volume through treatment							5.696	17.00%	
4.4.1 Amount of hazardous material destroyed or treated					5.172	49.7%	2.57	8.45%	
4.4.1a Reduction of volume	2469	1.042	32.0%	0.333				2.70%	
4.4.1b TRU concentration	Lognormal (2.18,1)	10	22.5%	2.250				1.90%	
4.4.1c Cadmium concentration	Lognormal (1.140e-004,1)	10	7.58%	0.758				0.64%	

Table C-7. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
4.4.1d Lead concentration	Lognormal (1.570e-003,1)	10	7.58%	0.758				0.64%	
4.4.1e Mercury concentration	Lognormal (1.330e-003,1)	6.37	7.58%	0.483				0.64%	
4.4.1f PCB concentration	Lognormal (3.33,1)	2.388	7.58%	0.181				0.64%	
4.4.1g TCE	Lognormal (0.7,1)	4.663	7.58%	0.353				0.64%	
4.4.1h BEHP	Lognormal (20,1)	0.7306	7.58%	0.055				0.64%	
4.4.2 Amount of principal threat treated to reduce toxicity, mobility, or volume					5.00	30.00%	1.50	5.10%	
4.4.2 Principle threat Cs-137	2.33	5	100.00%	5				5.10%	
4.4.3 Irreversibility of treatment of CFTs					8.02	15.00%	1.20	2.60%	
4.4.3 Irreversibility	Triangular (1000, 2000, 5000)	8.01	100.00%	8.01				2.60%	
4.4.4 Treatment residuals					8.00	5.3%	0.424	0.9%	
4.4.4 Secondary waste	60	8.0	100.00%	8.0				0.9%	
Alternative 3.b—Cost:									0.79
4.5 Cost							6.112	13.00%	
Cost					6.112	100.00%	6.112	13.00%	
4.5 Life-cycle cost	Triangular (2.21e+7, 2.94e+7, 3.38e+7)	6.112	100.00%	6.112				13.00%	

Table C-7. (continued).

Value Function	Input Parameter	Output Value	Relative Output Weight within Subcriteria	Weighted Contribution to Subcriteria Score	Subcriteria Score	Relative Subcriteria Weight	Criteria Score	Model Weight	Alternative Score
Alternative 3.b—Other Waste Streams:									0.23
4.6 Application to other waste streams							5.66	4.00%	
Other applicability					5.67	100.00%	5.66	4.00%	
4.6a Applicability to ARA-16 waste	8	8	33.33%	2.667				1.33%	
4.6b Applicability to PM-2A waste	7	7	33.33%	2.333				1.33%	
4.6c Applicability to investigation-derived waste	2	2	33.33%	0.667				1.33%	
Total Score for Alternative 3.b									7.1

Appendix D

Agency Comments and Resolutions

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PROJECT DOCUMENT REVIEW RECORD

DOCUMENT TITLE/DESCRIPTION: The Technology Evaluation Report for the V-tanks, TSF-09/18 at Waste Area Group 1, Operable Unit 1-10 (Draft), DOE/ID-11038, November 2002

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
SPECIFIC COMMENTS				
1 x	1	2, Figure 2	Extend length dimension on Tank to indicate ~19.5 ft, instead of 16 ft, to make it consistent with the Proposed Plan and proposed ROD Amendment.	Comment Accepted. Figure 2 will be revised to show a length of 19.5 ft, with the lines extended farther out, to near the ends of the tank.
2 x	1.1	4, 1st paragraph	Modify the TER as appropriate to indicate removal of 6000 gal of liquid may not be performed for the CO/S alternatives. The comparative evaluation can stand as is though (assuming 6000 gal is removed during early remedial action) since eliminating the removal will tend to favor the CO/S alternatives even more.	Comment accepted. The paragraph on page 4 shall be changed to read: "Table 3 provides the composition of each of the V-tanks and the overall weighted average for each of the CFTs, as well as other major constituents. The table includes two columns under the "Tank V-3" and "Average" tank concentration headings. One column under each of these headings provides information on current V-3 and Average tank concentrations, while the other column under each of these headings provides V-3 and Average tank concentrations after 6000 gal of supernatant has been removed from Tank V-3. "The mass balances described and referenced in these reports are based on the assumption that 6000 gal of liquid supernatant was removed from Tank V-3, prior to initiating the various technologies. Since that time, however, a decision has been made to not remove 6000 gal of liquid supernatant from Tank V-3, prior to tank remediation (provided the preferred alternative is ultimately selected). The effect of this change is not significant enough to affect the overall technology evaluation effort. As a result, there is no desire to change the referenced mass balances in this report."

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
3 x	1.1	4-5, Table 3	The data in Table 3 needs to be changed to reflect the concentrations with and without the 6000 gallons of liquid removed from V-3.	Comment accepted. The Table shall be revised, with a new column for Tank V-3 added in front of the existing V-3 column, and a second new column for the "Average" concentration added in front of the existing "Average" column. These new columns shall show the determined V-3 and average concentrations, assuming that 6000 gal of liquid supernatant is not removed from Tank V-3, prior to remediation. Subheadings shall then be added to the Table, for all "V-3" and "Average" columns. The new columns shall have the subheading "As Is", while the old columns shall have the heading "6000 gal of Liquid Removed". Since Table 3 is expanding by two columns, it should be setup in landscape, and span two full pages. This should give us enough room for our changes.
4 x	1.2	6, 7th bullet	The original assumption was that GAC filters could be disposed of at the ICDF as debris waste, provided the filters were kept under a 500 ppm TOC concentration. This assumption is no longer valid, and the VOC limits (PCE, TCE, TCA) for GAC disposal at the ICDF are now 6 ppm. This may affect the ability for disposing of GAC filters at the ICDF, for both the IS-CO/S and ES-CO/S options. The decision analysis needs to be rerun to identify this.	Comment was used to modify the decision analysis model to indicate that the TSDF control factors for IS-CO/S and ES-CO/S have been changed to the same input value (7.5, instead of 10) as ISV, and ESV. In addition the Community Protection input values for IS-CO/S and ES-CO/S have been changed to the same input value (8, instead of 10) as ISV and ESV. In addition, the bullet will be changed to three bullets, as follows: • "Macro-encapsulation can be performed on those off-gas units that are not granular in form (such as HEPA filters), provided other WACs are met (e.g., less than 500 ppm total organic carbon [TOC] for ICDF). • Macroencapsulation cannot be performed on those off-gas units that are granular in form (such as GAC and SGAC filters). As a result, they can only be disposed of at the ICDF if they meet Land Disposal Restrictions (LDRs) (i.e., 6 ppm TCE, TCE and PCE, 10 ppm PCB, and 28 ppm BEHP). • Disposal of SGAC filters are allowed at the ICDF, provided they meet LDRs."

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
5 x	1.2	Missing bullet	Include an assumption that 6000 gal of supernatant would be removed from tank V-3, prior to any remediation operation, for the purposes of completing the comparative analysis. Indicate that this may not actually be done for the CO/S alternatives.	Comment accepted. The new bullet says: "For comparative analysis purposes, all proposed remediation technologies were to be initiated after 6000 gal of liquid supernatant had been pre-removed from Tank V-3. This may not actually be done for the chemical oxidation/stabilization technology alternatives, however."
6 x	3	Page 23, last paragraph	With the decision to not pre-remove the 6000 gal of excess supernatant from V-3, prior to remediation, the last sentence in this paragraph needs to be changed to past tense, and the word "originally" needs to be applied to the assumed part of the sentence.	Comment accepted. The last sentence on page 23 (continuing into page 24) now reads: "For each of the alternatives identified above, it was assumed that a portion of the liquid (approximately 6000 gal) from Tank V-3 was decanted, treated, stabilized, and disposed of at the ICDF, prior to the treatment of the remaining sludge and liquid in the tanks."
7 x	3	Page 24	With the decision to not pre-remove the 6000 gal of excess supernatant from V-3, additional words need to be added, following the bullets, stating: 1) that since the time of the original assumption, it has been decided to not remove the 6000 gal from Tank V-3, and 2) that this revised decision did not significantly affect the decision analysis evaluation that had been performed under the original decision, even though it did affect the mass balances that are summarized here (and will not be changed).	Comment accepted. A new paragraph has been added below the bullets on page 24 (Section 3). The new paragraph is as follows: "Since the time of the V-tank technology evaluation, it has been decided to not remove 6000 gal of liquid supernatant from Tank V-3, prior to initiating V-tank remediation. The reason for this change is that excess liquid present in Tank V-3 could be used to assist in implementation of the preferred remediation technology (ex situ chemical oxidation, followed by stabilization) without having to add additional water to the tank wastes. Leaving the excess supernatant in the V-tanks allows for effective minimization of the resulting waste volume associated with V-tank remediation. Although the revised decision will ultimately affect the mass balances associated with each tank, it would not significantly impact the results of the decision analysis evaluation that was made under the original assumption. For this reason, a decision was made to not redo the mass balances for any of the seven technologies under consideration."

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
8 x	3.7	General (p. 45)	Additional Process Description is needed for ES-CO/S, since it is the preferred technology under consideration.	Comment accepted. The second and third paragraphs of this section now read as follows: "In the proposed alternative under consideration, the waste from the V-tanks is initially consolidated into three tanks by pumping the contents from Tank V-9 into Tank V-2. Ex situ chemical oxidation/reduction is then performed in batches of "to be determined" volume, pumped sequentially out of each of the three consolidated tanks. The supernatant and sediment phase within each tank is initially mixed together to produce more uniform batches within the reaction vessel, where the chemical oxidation or reduction reaction is to take place. The proposed mixing process involves transferring a portion of the tank wastes into a holding vessel, and then discharging it back into the tank at high pressure, to better stir up the tank contents. This process is repeated, until it is felt that the tank supernatant and residue phases are felt to be sufficiently mixed that heavier residues in the tank will have been well-mixed in with the other tank residues and liquids. The mixed tank waste is then transferred to the reaction vessel using the same system that was initially used to mix the tank contents. "Once in the reaction vessel, the waste will be stirred to maintain its level of mixing. Prior to and during chemical oxidation/reduction, the stirred tank waste will be adjusted and maintained at a controlled pH, as necessary. This is needed to maintain an optimal environment in the reaction vessel, which should enhance the chemical oxidation or reduction reaction. Charges of chemical oxidant (or reductant) are then introduced in stages to the stirred tank, to allow for chemical oxidation (or reduction) of tank contents in a batch processing manner. The purpose of the initial charge will focus on the volatile organic contaminants that are present in the waste, so there is a desire to minimize the temperature of the reaction vessel during this initial phase, provided the temperature is sufficient to promote chemical oxidation (or reduction). Later charges will focus on the chemical oxidation (or reduction) of the PCBs and oil components that are present in the tank sludge. As a result, this charge may use heating to enhance the chemical oxidation, if necessary. The preliminary evaluation assumed that the chemical oxidant to be used for this technology would be sodium

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
8 (cont.)	3.7 (cont.)	General (p. 45, cont.)		peroxy-disulfate. However, the actual chemical oxidant or reductant for this proposed system will not be defined until a conceptual design has been performed. "During chemical oxidation (or reduction), it is expected that there will be significant volatilization of hazardous VOCs into the off-gas system. To attempt a more complete oxidation (or reduction), plans are to condense the bulk of the volatilized organics in a condenser, with the condensate recycled back to the reaction vessel. Plans are to also include GAC, SGAC, and HEPA filters between the condenser and the off-gas blower (prior to stack release), to fully capture non-condensable hazardous off-gases and respirable particulate, prior to their release to the environment. The GAC should capture residual organic vapors, the SGAC should capture residual mercury vapors, and the HEPA filter should guarantee that the bulk of any radioactive materials are captured in the off-gas system, prior to stack release. "Once a batch chemical oxidation (or reduction) is complete, the contents of the reaction vessel will be transferred to a new tank system, where it will be mixed with cementitious grout, for stabilization purposes. Plans are to stabilize the chemically oxidized (or reduced) batch in the same container that it will be disposed of at the ICDF. Upon removing the chemically oxidized (or reduced) waste from the reaction vessel, the tank can be recharged with another batch of well-mixed tank sludge. This continues until the entire contents of the three tanks have been oxidized (or reduced) and stabilized. "The mass balance for this process is the same as that shown for the in situ chemical oxidation alternative (see Table 14). Upon completion, plans are to dispose of the SGAC filters at the ICDF and the GAC filters at an off-Site TSDF. "While the proposed process is designed for initial tank consolidation, followed by chemical oxidation with sodium peroxydisulfate (and stabilization with grout), one is reminded that this process is only a pre-conceptual effort, designed to evaluate this potential technology against all other technologies under consideration. Conceptual designs and title designs for this approach may differ considerably."

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
8 (cont.)	3.7 (cont.)	General (p. 45, cont.)		These paragraphs should also be acceptable as a response to one of the EPA comments, asking for more information on stabilization.
9 x	3.6	Page 44, Table 15	The secondary waste volume associated with IS-CO/S's non-recoverable equipment needs to be modified to 42 m3, to account for the additional 34 m3 of AEA equipment not included in the original evaluation (IS-CO/S assumed 1 m3 for the AEA equipment, rather than 35 m3). As a result, the total secondary waste volume in this table needs to also be changed to 44 m3.	Comment accepted. Table 15 will be revised such that the total secondary waste volume is 44 m3, and the secondary waste volume described as "Used PPE, consumable materials, non-recoverable equipment" is 42 m3.
10 x	3.7	Page 46, Table 16	The secondary waste volume associated with ES-CO/S's non-recoverable equipment needs to be modified to 58 m3, to account for the additional 34 m3 of AEA equipment not included in the original evaluation (IS-CO/S assumed 1 m3 for the AEA equipment, rather than 35 m3). As a result, the total secondary waste volume in this table needs to also be changed to 60 m3.	Comment accepted. Table 16 will be revised such that the total secondary waste volume is 60 m3, and the secondary waste volume described as "Used PPE, consumable materials, non-recoverable equipment" is 58 m3.
11 x	Section 3	All technologies	Since GAC filters cannot be disposed of as debris at the ICDF, Tables 15 & 16 need to be revised. The tables need to state that the GAC filters for IS-CO/S and ES-CO/S will be disposed of at Envirocare. This is because the estimated concentrations of PCE, TCE, and TCA in these filters will be above 6 ppm. The words in Sections 3.6, and 3.7 need to also be changed to reflect this.	Comment accepted. Tables 15 and 16 have been changed, showing that "Envirocare" will be the Expected Disposition for the GAC filters. In addition, the last two sentences on Page 42 are revised as follows: "Any VOCs not condensed are captured on a granular activated carbon (GAC) bed that will be treated and disposed of at an off-site TSDF (since VOC concentrations are expected to be over 6 ppm). If there are residual mercury vapors, they are captured on sulfur-impregnated GAC bed that can be disposed of at the ICDF, since it is not expected to be a RCRA characteristic waste"

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
12 x	Section 4.2.2	Pages 54	The section on administrative feasibility, which implies that each technology's Administrative Feasibility rating should be based solely on the ability to obtain regulatory approval, in the form of waiver/determinations of equivalent treatment, is not felt to be complete. This comment was generated after hearing about Administrative Feasibility concerns that are internal to the INEEL, rather than just supporting regulatory waivers, or determinations of equivalent treatment. Administrative Feasibility ratings need to also include concerns over internal administrative processes, such as SARs and Readiness Reviews. In addition, the section also states that Determinations of Equivalent Treatment are Regulatory Waivers. This is not correct. The paragraph at the start of 4.2.2 needs to suggest that on the basis of our review of all seven technology systems, that there are no regulatory wavers needing to be asked for. Instead, it should be stated that there are administrative processes/permission, such as determinations of equivalent treatment, that need to be granted for some of these technology systems.	Comment accepted. The 1st paragraph of Section 4.2.2 will be changed to read as follows: "The sub-criterion addresses the feasibility of obtaining both internal and external administrative approval to proceed with each proposed technology at the INEEL. The Administrative Feasibility sub-criterion is associated with administrative approvals from INEEL management, as well as Agencies involved in Environmental Remediation decision making at the INEEL (e.g., DOE-ID, IDEQ, and EPA Region 10) and other agencies involved in off-site disposal decisions (as applicable). "To facilitate the determination of each technology's Administrative Feasibility rating, a metric was developed based on five major administrative processes, and their estimated complexity for each of the seven technologies under consideration. The five major administrative processes include: • completion of the Safety Analysis Documentation for the proposed technology, • completion of the Operational Readiness Review process for the proposed technology, • the issue of obtaining approval for each technology as an acceptable alternative for retorting mercury, • the issue of obtaining approval for each technology as an alternative process for PCB destruction, and • obtaining approval for off-site disposal of the primary waste stream, after treatment (if applicable). "Each proposed technology will be assigned a assigned a level of complexity between 0 and 1 (in 0.25 increments), for each of these major administrative processes. The sum of these complexities will then be added up to define a total Administrative Feasibility complexity input value, between 0 and 5, for each proposed technology. These input values will then be applied to the inverse-linear curve shown in Figure 19."

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
12 (cont.)	Section 4.2.2 (cont.)	Page 54 (cont.)		Figure 19 needs to then be changed to reflect a 0-5 range, with the abscissa titled "Administrative Approval Complexity" In the second paragraph of this Section (page 55), change the term "...waivers or permissions..." in the first sentence to "...additional administrative approvals..." Finally, delete the last paragraph in Section 4.2.2 (also page 55).
13 x	4.5.1	Page 64, Last paragraph	The words, regarding Figures 34-39, need to state that the weighting for each of these factors is done on a reverse log basis, over the two orders of magnitude better than the current limitations of concentration, from an LDR standpoint.	Comment accepted. The new paragraph, at the bottom of page 64, now reads: "Figures 34-39 show the value functions metrics for reduction in toxicity and/or mobility of cadmium, lead, mercury, TCE, PCBs, and BEHP. The scale for each value function metric is an inverse log scale, covering two orders of magnitude, with the lower scale defined as the LDR concentration (or leachate value), and the higher scale defined as 1% of the LDR concentration (or leachate value). The value functions chosen for these measures produce: 1) an output score of 10 (best) if the proposed technology system results in a TCLP or totals concentration at least two orders of magnitude lower than the LDR limit; 2) an output score of 5 if the proposed technology results in a TCLP or totals concentration one order of magnitude below LDR limits; and 3) an output score of 0 (worst) if the proposed technology is not expected to meet LDRs. Input values for each technology system were determined by estimating the resulting concentration (or leachate value) for each identified contaminant, following treatment."
14 x	4.9	Table 17 Figures (generic)	All tables shown in the large Table 17 need to be modified to make certain that the output values associated with each technology's rating, are accurately indicated by the arrows. This is particular on the Graphs shown on pages 77, 79, 83, 84, 87, 89, 99 (significant error), and 108.	Comment accepted. The arrows on the various Figures will be modified to provide better indication of the resulting outputs. One should not perform this on the Figures shown on pages 81, 83, 87, 104, and 105, however, until after new curves have been obtained from the new decision analysis model run.

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
15 x	4.9	Page 81	Consistent with comment 11, the curve shown on this Figure, and the overall discussion of Administrative Feasibility should be changed to incorporate Administrative Feasibility issues internal to INEEL management (such as SAR and Readiness Review approvals), as well as external with Agencies and off-site administrators. This factor also needs to be modified in wording, to state that it is not regulatory waivers that are needed, since we don't need waivers. Suggest that the wording be changed by dropping all references to waivers, and only keeping the Administrative/Permissions from other DOE sites or TSDFs.	Comment accepted. Criterion Column The subtitle of "4.2.2, Administrative Feasibility" will be renamed "Number and Complexity of Required Administrative Process Approvals". The waiver scale shall be changed to a "0-5 Administrative Approval Scale", with the "Complexity Scale" defined" as "0-1, 0.25 increments ". The "Note paragraph should be modified to read: "Input is obtained by adding up the complexities for: Safety documentation (SD), Operational readiness (OR), Hg retort alternative (Hg), PCB destruction alternative (PCB), & Off-Site Disposal (OD)" Input Parameter Column This column needs to be revised to show complexity values for each major administrative process and technology. The column should first start with a parenthesis showing "(SD+OR+Hg+PCB+OD = TOTAL)", identifying the order of the complexity values, and the total complexity value associated with each technology. The values applied to each technology are as follows: "ISV: "1+0.5+.25+.25+0=2; ESV: ".75+.75+.25+.25+0=2" TD on/off-Site: ".5+.25+0+0+0=.75" TD on-Site: ".75+1+.25+0+0=2" TD off-Site: ".5+.75+0+0+1=2.25" IS-CO/S: ".75+.5+.5+.5+0=2.25" ES-CO/S: ".5+.25+.5+.5+0=1.75". The Figure on Page 81 will then be modified such that the new abscissas will read "Administrative Approval Complexity", and the Figure will have a range of 0-5, not 0-4. New areas, tied to the input parameters, shall then be added to the figure (make sure outputs are properly identified). Finally, the "Justification" column needs to be rewritten, as follows:

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
15 (cont.)	4.9 (cont.)	Page 81 (cont.)		"ISV has historically had significant SD complexity. Its extensive use warrants a moderate OR ranking. ISV needs Alternate Treatment Standard (ATS) acceptance (and a TSCA risked base petition) for both Hg retort & PCB destruction. Both are of minor complexity, however. "ESV has slightly less SD complexity than ISV, due to its ex situ nature. It is less developed, however, increasing OR ranking. Its similarity to Hg retort & PCB destruction make ATS/TSCA approvals a minor complexity. "TD on/off-Site has moderate SD complexity & minor OR complexity, due to its ex situ nature, small number of components & lack of a thermal oxidizer (TO). It meets Hg retort & PCB destruction requirements. "TD on-Site uses a TO to treat the organic contaminants. This raises SD complexity to major & OR complexity to extreme. It meets PCB destruction, requirements & is similar to approved Hg retort guidelines. "TD off-Site is expected to have moderate SD complexity & major OR complexity, due to its potential for high radiation exposures. It meets Hg retort & PCB destruction requirements. It requires off-Site disposal of the treated primary waste stream. This is further complicated by its unknown status as TRU on non-TRU waste. "IS-CO/S has major SD complexity & moderate OR complexity, due to its in situ, untried nature. ATS/TSCA approvals for Hg retort & PCB destruction are more complex, since they aren't similar to approved processes. "ES-CO/S is expected to have moderate SD complexity & minor OR complexity, due to its ex situ nature. ATS/TSCA approvals for Hg retort & PCB destruction are similar to IS-CO/S (see above)."

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
16 x	4.9	Page 83	The justification section of the INEEL Control Factor (for TSD Facilities) needs to be modified to reflect recent information indicating that the GAC beds for Options 5 and 6 (IS-CO/S and ES-CO/S) will have to be dispositioned off-site, since the VOC concentrations are greater than LDR requirements (See Table 14). This is a significant change for IS-CO/S and ES-CO/S, that requires reducing their input parameters to 7.5, rather than 10, which is equivalent to the same input parameters that are identified for ISV and ESV. In addition, the TSD control factor for Option 4 (TD on-Site) needs to have its input parameter changed to 10 (from 7.5), to reflect information, already identified in Table 11, that all of the generated waste can be disposed of on-Site (since the thermal oxidizer, in front of the GAC bed, should destroy organic contaminants sufficiently that the VOC content on the GAC bed will be below LDR limits).	Comment accepted. The input parameter for TD on Site now reads "10", while the input parameters for IS-CO/S and ES-CO/S now read "7.5". In addition, the Justification section for this criterion now reads: 1st paragraph: "The vitrification alternatives and chemical oxidation (with stabilization) alternatives produce only one waste stream requiring off-Site disposal: the GAC bed. (The ICDF cannot accept GAC filters that do not meet LDRs). The rest of the waste from these four alternatives can be disposed of at the ICDF (including SGAC beds)." 4th paragraph: "The TD on-Site alternative can dispose of all of its waste on-Site (at the ICDF)." Also delete the "Note" at the bottom of the justification section. Finally, adjust the Figure arrows accordingly and eliminate the "(or Envirocare)" statement from the PPE disposition for the TD on-Site alternative, in Table 11 of the TER. All TD on-Site option waste will be disposed of at the ICDF.
17 x	4.9	Page 87	TD on-Site's input value for Community Protection needs to be changed from 8 to 10, since the Thermal Oxidizer unit should destroy all organic contaminants to CO2, so no hazardous VOCs should be captured on the GAC (the GAC will not require off-Site disposal). This makes it consistent with Table 11. IS-CO/S's and ES-CO/S's input value for Community Protection needs to be changed from 10 to 8, to reflect the fact that the GAC beds will have to be disposed of off-Site, just like ISV and ESV, since they cannot be disposed of as debris. As a result, they need to meet LDR limits for VOC concentration, something not consistent with Table 14.	Comment accepted. The input parameter for the TD on-Site option shall be changed to "10", and the input parameters for the IS-CO/S and ES-CO/S options will be changed to "8". In addition, the Justification section for this criterion now reads: 1st paragraph: "The vitrification and chemical oxidation (with stabilization) alternatives require disposal of their GAC beds off-site, which, in turn, requires transportation of a solid, untreated waste. The remainder of the waste is sent to the ICDF" 3rd paragraph: "The TD on-Site alternative involves no off-Site shipments." Also delete the "Note" at the bottom of the justification section. Finally, adjust the Figure arrows accordingly.

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18 x	4.9, and Appendix C	Figure 48 on page 75	With the decrease in the range of secondary waste volume, associated with the model (40-140 m3, instead of 10-140 m3), the model weight associated with the Primary Waste Volume factor needs to be changed from 2.5% to 2.7%, while the model weight associated with Treatment Residual Volume needs to be changed from 1.1% to 0.9%. This change maintains the relative weights of Primary and Secondary waste volumes, while also maintaining a total weight for all waste volumes of 3.6%, as previously agreed upon. The Figure on page 75, showing the percentage of TMV associated with treatment residuals and material treated or destroyed will have to be changed to reflect this.	Comment accepted. This change has been incorporated in the new decision analysis model run. The portion of Figure 48 on page 75 will be modified to reflect the fact that treatment residuals now is only 5.3% (not 10%) of TMV, while Material Treated or Destroyed now is 49.7% (not 45%).
19 x	4.9	Page 103 Figure	The Figure on this page shows that the curve assignations are in terms of less than values. To make this more understandable, it is suggested that the "<" symbol be changed with the "~" symbol. This would better delineate the values that are established for the curve.	Comment accepted. The curves on pages 103 and 168 (Figure 41) need to be modified such that the "<" term is replaced with the "~" term.
20 x	4.9	Page 104	A review of the PCDR has found that IS-CO/S and ES-CO/S inaccurately identified the secondary waste volume associated with the AEA pumping system, by 34 m^3. The other technology systems correctly identified the AEA waste volume as 35 m^3, while IS-CO/S and ES-CO/S identified the AEA waste volume as only 1 m^3. To make the evaluations consistent, the input parameter for IS-CO/S needs to be changed from 10 m^3 to 44 m^3, and the input parameter for ES-CO/S needs to be changed from 26 m^3 to 60 m^3. The effect of this change will also shrink the scale of this criterion to 100 m^3 (40-140 m^3), rather than 130 m^3 (10-140 m^3). This needs to also be corrected.	Comment accepted. The Input Parameters for IS-CO/S and ES-CO/S should read 44 m^3 and 60 m^3 respectively. The curve shown in this Figure (and Figure 42, on Page 69) needs to be modified, such that the range is now 40-140 m^3, not 10-140 m^3. The scale on this page should be changed to read "40-140 m^3". And the arrows on the Figure on Page 104 should be modified to reflect the new, accurate outputs, for each of the seven technologies. The weight changes associated with this modification will be identified in Appendix B and C. These changes have been incorporated in the new Decision Analysis model run.

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21 x	4.9	p. 105, Fig. 43 (p.70), & Sect. 4.6 (p. 69)	The life-cycle costs have been corrected for the draft Proposed Plan, to reflect Present Day value costs, minus Escalation, but with O&M costs added. The total corrected costs for each of these technologies need to be input into this Figure and description of life-cycle costs on this page, so that the costs identified in the Proposed Plan are consistent with what's reported in this report. According to the Proposed Plan, the corrected input parameters for the various technologies are: • ISV-$33.0 M; • ESV-$32.7 M; • TD on/off-Site-$30.3 M; • TD on-Site-$30.3 M; • TD off-Site-$33.8 M; • IS-CO/S-$29.5 M; and • ES-CO/S-$29.4 M. As a result of these changes, the range of the curve needs to be changed to $22.1-$38.9 M, to reflect the assumption that the range is based on -25% of the lowest cost alternative, and +15% of the highest cost alternative. The model weight (identified in Appendix C) does not have to change, however.	Comment accepted. The scale identified in this page needs to be changed to $22.1-38.9 M (the -25%/+15% criteria is still valid). The new input parameters for each of the seven technologies are as shown in the comment. The section on justification needs to be modified, by eliminating "escalation and contingency" from the last sentence, and adding a new sentence, stating: "The cost values have then been reported in terms of net present value, minus escalation costs." The Figure on this page needs to be revised to show the new scale and new arrows specifying the output for each technology system. The Figure on page 70 (Figure 43) needs to also be modified to include the new range scale ($22.1-$38.9 M). In addition, the words on page 69 (Section 4.6) need to be modified to describe the modified cost values. This will require the following changes: 1st paragraph, last sentence: "Agreement was reached with the Agencies to use life-cycle costs (without escalation) that are discounted to net present value, for this metric."
22 x	5.1	Page 109, Table 18; Page 110, Figure 45.	A new Decision Analysis Model needs to be run, to reflect the changes to the model that have been identified in Comments 14, 15, 16, 17, 18, 20, 21, 27 and 28. The results of this model needs to then be input into a revised version of this Table, that reflects the new model inputs. The calculated values in Table 18 should also only be reported to three significant digits.	Comment accepted. This has been performed, with the changed inputs and weighting factors, but still awaits validation. The un-validated results of this new decision analysis are shown in Table 18 (to three significant digits), to reflect the correct values for the new Decision Analysis Model run. This new Decision Analysis Model run will also require a revised Figure 45 that will be corrected, after the model run is validated.

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23 x	5.1	General	The section should provide information on how the data from Table 18 was used to prepare Table 3 of the Proposed Plan.. Words should also be added, similar to what's in the Proposed Plan, identifying what factors played significant influence in making ES-CO/S the preferred technology, over the other six technologies under consideration.	Comment accepted. The second paragraph on page 109 will be modified as follows: "The results of the Decision Analysis Model run, in support of selecting a preferred technology for V-tank remediation, is shown in Table 18. Figure 45 shows a comparison of the various technology systems, compared to the mean value rating for all seven technologies. "A relative evaluation was then made, to assist in overall determination and selection of the preferred technology. The results of the relative evaluation are shown in Table 3 of the Proposed Plan. The relative evaluation was made by spreading the range of absolute values given to each technology, for each major sub-criterion, across a 0-10 scale, then ranking these sub-criteria as "Low", "Moderate" or "High" for each technology. A relative ranking of 0-2 earned a "Low" ranking, a relative ranking of 2-8 earned a "Moderate" ranking, and a relative ranking of 8-10 earned a "High" ranking." Finally, a new paragraph has been added after the bottom paragraph on page 109, to reflect the significant strengths and weaknesses of the various technologies, relative to the preferred technology (ES-CO/S). The new paragraph, following the bottom paragraph on page 109, is as follows: "The ES-CO/S option is preferred over the other alternatives because it is a low-temperature operation, with a simplified off-gas treatment system, that generates a stabilized waste disposed of at the ICDF. Compared to the ISV alternative, ES-CO/S has fewer potential hazards to workers, fewer monitoring concerns, lower costs, and higher system reliability, which more than offsets ISV's relative strengths with regards to technology maturity, less primary waste volume, and increased treatment capability for Investigation Derived Waste (IDW). Compared to the ESV alternative, ES-CO/S has fewer potential hazards to workers, lower costs, and higher system reliability, which more than offsets ESV's relative strength with regards to the ability to treat IDW. Compared to the TD on/off-Site alternative, ES-CO/S has more controllable disposal facilities, fewer off-Site shipments, and fewer

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23 (cont.)	5.1 (cont.)	General (cont.)		potential hazards to workers, which more than offsets TD on/off-Site's increased administrative feasibility. Compared to the TD on-Site alternative, ES-CO/S has fewer potential hazards to workers and higher system reliability, which more than offsets TD on-Site's relative strengths with regards to more controllable disposal facilities and fewer off-Site shipments. Compared to TD off-Site, ES-CO/S has fewer potential hazards to workers, more readily available disposal facilities, lower costs, fewer required off-Site shipments, better system reliability, and a shorter ROD completion time. ES-CO/S's only significant strength over IS-CO/S is that it is a more mature treatment technology. However, that is sufficient to pick it over IS-CO/S, since there are no significant strengths associated with IS-CO/S (relative to ES-CO/S)."
24 x	Appendix A	General	These treatment alternative cost estimates need to be modified, to make them consistent with the totals that were used in the revised Decision Analysis Model for this report. To do this, it is recommended that all Escalation be removed from the spreadsheets. O&M costs should then be added to the spreadsheets, for all out years, along with their projected out-year factor. The spreadsheets should factor up to all projected costs, not discounted to present value. An additional sheet should then be added at the back of each Cost Estimate (for each particular technology), identifying the total costs associated with each particular year, with the costs discounted to present value.	Comment accepted. Plans are to make this modification. The plans will involve removing the escalation column from the current estimates, then adding a page to each estimate addressing what costs are by year, and the discount factor associated with each yearly cost.

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25 x	Appendix B	General	The Relative Weights and Model Weights Identified in this Appendix are not consistent with the Relative Output Weights, Relative Sub-criteria Weights, and Model Weights identified in Appendix C. They need to be corrected, but not until after the new Decision Model has been run, and a new Appendix C has been prepared.	Comment accepted. Appendix B will be modified to be consistent with Appendix C, once a new Appendix C has been prepared. The Appendix B shall have the following changes: 2.1.2 Input Range changed to "complexity number summed over 5 pre-identified administrative actions" "2.1.3" Needs to be added to the Availability of Service and Materials heading. 2.1.1.2 on Input Range, add ", between 8 and 16" 2.2.1a on Input Range, add ". 1-4 year range" 2.2.1b on Input Range, add ", 1-6 year range" "2.2.2" needs to be added to the Community Protection Heading "2.2.3" Needs to be added to the Worker Protection Heading" 2.2.3a on Input Range, change to "up to 7 different hazard types, 3-6 range" "2.2.3" Needs to be added to Environmental Impacts heading "2.3.1" needs to be added to Residual Risk heading Input Range on 2.3.1 and 2.3.2 needs to be changed to "Clean or non-Clean Closure" "2.3.2" needs to be added to Controls heading "2.4.1" needs to be added to Amount of Hazardous Material Destroyed or Treated heading. Change relative weight rating, within category, to "49.7%. Change Model Weight to "8.5%" 2.4.1a Change Relative Weight Within Category to "32%". Change Model Weight to "2.7%". Add ", 2200-2500 m3 range" under Input Range 2.4.1b Change Relative Weight Within Category to "22.67%".

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ITEM NUMBER	**SECTION NUMBER**	**PAGE NUMBER**	**COMMENT**	**RESOLUTION**
25 (cont.)	Appendix B (cont.)	General (cont.)		2.4.1c,d & e Change Relative Weights Within Category to "7.56%". Change "Number" in Input Range to "Leachate Concentration, 1-100% of TCLP)" 2.4.f & g Change Relative Weights Within Category to "7.56%". Change "Number" in Input Range to "Concentration, 1-100% of TCLP)" 2.4.1g Add "Concentration" after "TCE" in Heading. Add new row: 2.4.1h Value Function: "BEHP Concentration", State Variable Input: "PBHP", Input Range: "number (mg/kg), Output Variable Label: "PBHPV", Relative Weight Within Category: "7.56%", Model Weight: "0.76%" "2.4.2" needs to be added to Amount of Principle Threat Treated to Reduce Toxicity, Mobility or Volume" heading "2.4.3" needs to be added to Irreversibility of Treatment of COC's heading. Add "0-10,000 year range" to the Input Range "2.4.4" needs to be added to Treatment Residual heading. The Relative Weight Within Category needs to be changed to "5.3%". The Model Weight needs to be changed to "0.9%". The Input Range needs to be revised to state "number (m3), 40-140 m3 range" 2.5 Input Range needs to be changed to read "number ($M), $22.1M-$38.9 M range"
26 x	Appendix C	General	This Appendix C will have to be revised, to reflect the results of the new Decision Analysis Model run that was made for this report.	Comment accepted. Appendix C will be modified to be consistent with the new decision analysis model run. It will be consistent with Appendix B, and will include the changes to the New Decision Analysis Model Run that was described in Comments 14, 15, 16, 17, 18, 20, 21, 27 and 28.

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27 x	Appendix C	Output Values for Plant and Animal Impacts (all technologies)	The current Decision Model shows an output value of 0 for plant and animal impacts, on all technologies. Since all technologies had the same value, this was not a discriminator that changed the relative value of the various technologies. However, with the new Decision Analysis Model run, it is desired to change the model outputs for these factors to 10, for all seven technologies, to make it correct.	Comment accepted. This has been corrected in the new decision analysis model run. It will be identified in

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28 x	Appendix C	Triangu-lated Values	To make the new decision analysis consistent with what was performed before, as well as consistent with each technologies, there will need to be: • best case and worst-case values established for each new cost estimate. In addition, the best and worst-case option for IS-CO/S and ES-CO/S secondary waste will be eliminated, to make it more consistent with the other options. The effect of this comment is as follows: Cost Input / Best Case / Expected Case / Worst-Case ISV 24.7 33.0 37.9 ESV 24.5 32.7 37.6 TD on/off 22.7 30.3 34.8 TD on-Site 22.7 30.3 34.9 TD off-Site 25.3 33.8 38.9 IS-CO/S 22.1 29.5 33.9 ES-CO/S 22.1 29.4 33.8 Secondary Waste IS-CO/S None 44 None ES-CO/S None 60 None	Comment accepted. This was included in the new Decision Analysis Model Run.
29	General		A thorough edit needs to be performed on the document to guarantee that it is consistent with the proposed plan.	Comment accepted. A thorough edit has been performed.

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DATE: 01/07/03 **REVIEWER:** **EPA**

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GENERAL COMMENTS - The general comments are divided into two sub-sections (1) Critique of the Selection of the ES- CO/S process and (2) Critique of the ES-CO/S process.				
1	Critique of the Selection of ES-CO/S		This Report does not make a case for the need to use chemical oxidation with stabilization instead of stabilization alone. Accordingly, it is prudent to evaluate the alternative of stabilization alone without oxidation. Oxidation is primarily directed to address VOCs and SVOCs, which are all in ranges of concentrations that may be amenable with stabilization alone. Obviously, a treatability study will have to be carried possibly with the addition of other grouting agents to conclusively establish the viability of that option (implementing stabilization without oxidation). The option has significant cost saving potential. In addition, it has the added benefit of using fewer chemicals, lesser volume of final wastes, and thereby has fewer hazard potentials. Stabilization alone has been successfully used for addressing comparable levels of organic constituents. For example, Georgia Environmental Protection Division (GEPD) has approved several sites for in-situ stabilization. Four of them are as follows: Completed • Columbus, GA (1992) - VOA[1]=262ppm, PAH[2]=2385ppm • Network Underground (1994) - PCBs>50 ppm • Macon Manufactured Gas Plants (2002) Awaiting Award • Augusta Manufactured Gas Plants (2002) Stabilization was also the technology implemented to stabilize about 100,000 cubic yards of contaminated soil and sludge containing petroleum hydrocarbons with BTEX (Benzene, Toluene, Ethyl benzene and Xylenes) of 1,1018 mg/kg at a site in Indiana. The following two reports [(PTP, 2002) and (DOE, 1998)] would have been particularly relevant for review in considering stabilization alone. However, they were not received in time to support EPA's review.	**To be resolved by Rick Farnsworth.** No change to document. Stabilization was not considered further in this report, because it had already been evaluated and dismissed in the earlier Record of Decision (ROD) for the TAN V-tanks (DOE-ID-10682). On Part II, page 7-4 of the original ROD it states: "...the IDHW has determined, after the release of the Proposed Plan, that the V-tanks are part of a tank system and are subject to State of Idaho HWMA closure requirements. Based on this information, In Situ Stabilization does not meet ARARs since this technology will not meet the LDR ARARs." On page 7-5 of Part II of the original ROD, it implies that Alternative 3, which involved in situ stabilization of the tank contents without chemical oxidation, does not meet the CERCLA threshold criteria of Overall Protection of Human Health and the Environment, and compliance with ARARs. This is the primary reason that it was not considered further under the initial ROD. Since the time of the original ROD, there has been no change with regards to the V-tanks being considered a tank system that is subject to State of Idaho HWMA requirements. As a result, the concept of stabilization without chemical oxidation still does not meet the necessary ARARs. Therefore, stabilization alone, without oxidation, will not meet the CERCLA threshold criteria associated with ARAR compliance, and cannot be considered further, as part of the Technology Evaluation Report. This approach of ignoring those potential technologies that do not meet CERCLA thrshold criteria is documented in the Technology Evaluation Statement of Work that has been previously submitted to the agencies for their review. The comment refers to a number of sites, containing organic contamination, where stabilization has been approved. With CERCLA, certain ARARs (such as LDRs) can be negotiated. I assume that it has been done in these cases. With our case, however, IDEQ has stated that remediation of the tank contents would have to meet LDRs, prior to its disposition in a landfill (per Idaho HWMA closure requirements).

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DATE: 01/07/03 **REVIEWER:** **EPA**

ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
1 (cont.)	Critique of the Selection of ES-CO/S		a. PTP, 2002 *Transuranic and Mixed Waste Focus Area Testing and Demonstrations Project Final Report-Chemical Oxidation/Grouting Bench-Scale Testing of V-Tank Waste Surrogates*, MSE Technology Applications, Inc., PTP-108, September 2002) b. DOE, 1998, *Direct Chemical Oxidation,* OST Reference #109, prepared by Mixed Waste Focus Area.	To meet ICDF LDRs, the stabilized tank wastes would need to increase in mass by 21-2400 times, with the addition of stabilization materials. Such an increase in mass is not necessary for stabilization purposes, thereby constituting dilution. The high quantity of organic material present in the V-tank waste (up to 20 wt%) may also limit the effectiveness of the stabilization.
2	Critique of the Selection of ES-CO/S	NA	It appears for some reason chemical oxidation was chosen a priori. It is not clear from the text why the commonly used reductive technologies were not considered. Reduction by molasses (an inexpensive substrate), sodium dithionite, or sodium disulfide is typically used.	**Resolved by Dave Tyson.** Comment partially accepted. The selected option for the destruction of organics was chemical oxidation using free radical chemistry. There are two predominant modes for wet chemical destruction: reduction and oxidation. Reduction is primarily a "dehalogenation" process. In the classical sense, chlorides are stripped from existing halogenated hydrocarbons with the skeletal carbon base unaffected. As a result, undesired (hazardous) intermediates could be formed. Under reducing conditions, these intermediates could have limited reaction pathways that would allow for further transformation. Oxidation is a process that attacks the carbon bonds. The classical oxidation end products from the destruction of chlorinated hydrocarbons are carbon dioxide, water, and hydrogen chloride. Due to production of an acid (HCl), oxidation of chlorinated hydrocarbons will experience a drop in pH. Given a **suitable** amount of oxidant, it is felt that there is less likelihood of the formation of hazardous intermediates. To keep the TER more open to alternative treatments, the Chemical Oxidation and Stabilization Options will be expanded to include Chemical Reduction, prior to stabilization. However, it is expected that the aforementioned chemical reductants do not have a reductive strength that is equivalent to the oxidants that are being considered.

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
1	Critique of ES-CO/S		Even though Fenton's reagent was mentioned as a possible oxidant on page 63, the reason(s) for discarding it was not discussed. Fenton's reagent has a redox potential of 2.7 Volts (In-situ Oxidation Technology [ISOTEC], Lawrenceville, NJ). It also has the added advantage of producing oxidation without increasing the temperature which will avoid the expense and complication of moisture leaden off-gas and its treatment.	**Resolved by Eric Miller and Dale Cresap.** No change required to the document. Persulfate was selected for the purposes of convenience in evaluating CO/S against other technologies (i.e., vitrification and thermal desorption), as part of the Preconceptual Design effort. Efforts are currently underway (as part of the Conceptual Design) to evaluate all potential oxidants (including Fenton's reagent) for application to V-tanks wastes. It should be noted that only the hydroxyl radical portion of Fenton's reagent possesses the 2.7 V oxidation potential, while hydrogen peroxide possesses only a 1.78 V oxidation potential. In comparison, peroxydisulfate possesses a 2.01 V oxidation potential, while its accompanying radical (SO_4^-) possesses a 2.6 V oxidization potential. It is the the fraction of each associated radical in the chemical oxidation system that will determine the overall effectiveness of the oxidant, not the strength of the radicals themselves. For instance, assuming a 1:1 ratio of products to radicals for each case, the overall strength of Fenton's is 2.24 V (i.e., ((2.7+1.78)/2) while that of peroxydisulfate is 2.31 V ((2.6+2.01)/2). Fenton's reagent is also widely known to be the most aggressive oxidant in terms of both heat and gas generation.
2	Critique of ES-CO/S		The benefits of raising the pH level to 12 by adding sodium hydroxide have not been discussed. The need for such a pH increase should be provided.	**Resolved by Eric Miller and Dale Cresap.** Comment partially accepted. The Technology Evaluation Report does not stipulate a particular pH. Rather it simply states that an "alkaline" pH will be achieved. (The specification of a pH level of 12 is only discussed in the Pre-Conceptual Design report, which is not subject to revision.) Although not provided in this report, the rationale for the pH adjustment is that the groutability of the processed wastes in optimized at, or near, the pH of the neat grout used in the solidification. The pH of most cementitious grouts is in the range of pH 10 -12. This rationale will be added to the Technology Evaluation Report.

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SPECIFIC COMMENTS				
1	5, 3rd Paragraph	63	Fenton's Reagent and Permanganate solutions are mentioned as candidate oxidants here. However, they were not evaluated on page H-1 of Appendix H, and should be.	**Resolved by Eric Miller and Dale Cresap.** For information only, as this comment refers to the Pre-Conceptual Design Report. There is no need to adjust this report, since it is not part of the Administrative Record. Persulfate was selected for the purposes of convenience in evaluating CO/S against the other technologies (i.e., vitrification and thermal desorption), as part of the Preconceptual Design effort. Efforts are currently underway to evaluate all potential oxidants (including Fenton's reagent) for application to V-tanks wastes. It should be noted that only the hydroxyl radical portion of Fenton's reagent possesses the 2.7 V oxidation potential, while hydrogen peroxide possesses only a 1.78 V oxidation potential. In comparison, peroxydisulfate possesses a 2.01 V oxidation potential, while its accompanying radical ($SO_4^{\cdot}$) possesses a 2.6 V oxidization potential. It is the fraction of each associated radical in the chemical oxidation system that will determine the overall effectiveness of the oxidant, not the strength of the radicals themselves. For instance, assuming a 1:1 ratio of products to radicals for each case, the overall strength of Fenton's is 2.24 V (i.e., ((2.7+1.78)/2) while that of peroxydisulfate is 2.31 V ((2.6+2.01)/2). Fenton's reagent is also widely known to be the most aggressive oxidant in terms of both heat and gas generation. Therefore, its use needs to also be evaluated from a safety perspective.
2	5, 4th Paragraph	63	Neither the PTP, 2002, *(Transuranic and Mixed Waste Focus Area Testing and Demonstrations Project Final Report-Chemical Oxidation/Grouting Bench-Scale Testing of V-Tank Waste Surrogates,* MSE Technology Applications, Inc., PTP-108, September 2002) nor the DOE, 1998, *(Direct Chemical Oxidation,* OST Reference #109, prepared by Mixed Waste Focus Area) were not provided in time for review. Thus, one of the major underlying assumptions about the DREs could not be evaluated.	**Resolved by Rick Farnsworth.** We apologize for not providing these documents to you in time for your review. You should have them now. Please provide additional comments, after looking at them, if you desire. It should be remembered, however, that the proposed remediation strategies outlined in the Pre-Conceptual Design report were prepared to evaluate various technologies (i.e., chemical oxidation, vitrification and thermal desorption) against each other. Therefore, technological details discussed in the Pre-Conceptual Design report may be changed during Conceptual Design, as more is known of possible oxidants/reductants that may be used.

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DATE: 01/07/03 REVIEWER: EPA

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3	5.2.2, 3rd Bullet	66	The Specifications of the American Electronics Association (AEA) were not made available. The plausibility of the transfer of the entire contents of Tanks V-1, V-2, V-3 and V-9 to the reaction vessel could not be evaluated.	**Resolved by Rick Farnsworth.** For information only, as this comment refers to the Pre-Conceptual Design Report. There is no need to revise this report, since it will not become part of the Administrative Record. The term "AEA" does not refer to the American Electronics Association. Rather, it refers to the name of the company that manufactures the AEA pumping system. The initials "AEA" do not stand for anything. The assumption that the entire contents of Tanks V-1, V-2, V-3, and V-9 could be transferred to the reaction vessel, via the AEA system, is based on discussions held between V-tank personnel and personnel from AEA. The assumption is supported by recent surrogate testing activities, using the AEA system, that have been performed for the INEEL, in support of tank cleanup activities at the INEEL, performed in support of the Voluntary Consent Order (VCO).
4	5.5, 2nd Paragraph	71	It is indicated that the first aliquot [of the oxidant] will be added while the solution is at ambient temperature. The paragraph goes on to describe why this sequence is advantageous. However, on the detailed Mass Balance Sheets in Appendix A & C, for tanks V-1, V-2 & V-9, and V-3, the process describes heating the contents to 80° C first <u>before</u> the addition of the final aliquot of oxidant.	**Resolved by Rick Farnsworth.** The proposed remediation strategy outlined in the Pre-Conceptual Design report was for the purposes of convenience in evaluating CO/S against the other technologies (i.e., vitrification and thermal desorption). A new chemical addition strategy, possibly using other chemical oxidants or reductants (other than, or in combination with peroxydisulfate) will be developed as part of the Conceptual Design effort that is currently underway for the "Ex Situ Chemical Oxidation/Reduction, with Stabilization" strategy. Part of the reason for adding chemical oxidant or reductant to the tank sludge, prior to heating, is to avoid volatilization of the F-001 spent solvents in the tank, before they can be oxidized. The error noticed in the Pre-Conceptual Design report reflects a change in the proposed approach for Chemical Oxidation (pre-chemical addition, before heating) that was not consistently applied to the rest of the document. Nevertheless, since it is the Pre-Conceptual Design report, there is no need to make the correction, since the report will not be placed in the Administrative Record.

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PROJECT DOCUMENT REVIEW RECORD

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DATE: 01/07/03 **REVIEWER:** EPA

ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
5	5.6, 1st Paragraph	74	It is not clear what the protection against personnel exposure to radiation would be. It is mentioned "*As a result, all piping from the individual tanks to the GLRV, the GLRV itself, all piping from the GLRV to the grout mixer/extruder, and the mixer/extruder itself, may need to be shielded.*" Is it or is it not proposed that a two feet thick concrete structure with a half inch of lead shield be built enclosing all the appurtenances? Was the cost of such structure considered in the evaluation?	**Resolved by Rick Farnsworth.** For information only, as this comment refers to the Pre-Conceptual Design Report. There is no need to revise this report, since it will not be part of the Administrative Record. As previously stated, the proposed remediation strategy outlined in the Pre-Conceptual Design report was for the purposes of convenience in evaluating CO/S against the other technologies (i.e., vitrification and thermal desorption). A new strategy that includes shielding requirements will be developed as part of the Conceptual Design effort that is currently underway for the "Ex Situ Chemical Oxidation/ Reduction, with Stabilization" strategy. A 2-ft thick concrete structure was proposed in the pre-conceptual design effort, for shielding the transfer piping between the tanks and the reaction vessel. Shielding issues should be addressed, as part of the Conceptual Design effort. However, the actual shielding design has not yet been finalized.
6	Table 17	85	The length of time to remediate was to be the main descriminator in evaluating the short term effectiveness of the alternatives. By using years on the X axis this effectively removes this subcriterion as a descriminator.	**Resolved by Rick Farnsworth.** No change to document. The decision to evaluate time to remediate in terms of years, vs. shorter time periods, was made as part of the initial agency meeting that was used to support weighting factors. The decision was again agreed to in the second meeting with the Agencies, identifying the preferred remediation technology for the V-tanks. It is recognized that the value function, as currently defined, offers no discrimination to six of the seven identified technologies. At the time this decision was made, however, it was felt that discrimination at shorter time periods was felt to be of limited value to the public and Agencies. In essence, it was felt that concern over time to remediate should not provide a technology discriminator unless the proposed technology's time to remediate was over a year longer (or shorter) than other technologies.

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7	5.1, 1st Paragraph	110	EPA recommends deleting the 2nd sentence. This reads as if the criteria were adjusted to achieve the desired outcome. This was not the case.	**Resolved by Rick Farnsworth.** Comment accepted. The paragraph will be revised to read that the decision analysis model, with its pre-determined weighting factors, was presented to the Agencies for their consideration, along with the recommendation remediation alternative (ES-CO/S) for the V-tanks. The paragraph will also state that sensitvity analyses and pair-wise comparisons were performed at the Agencies' requests, to evaluate how the pre-determined weightings affected the recommended outcome. The paragraph will further state that results of the sensititivity analysis indicated that changes to the weighting factors could alter the relative rankings of six of the seven identified alternatives, but that the observed change in "technology value" was not significant enough to support a change in the recommended technology. Information supporting the decision (from the sensitivity analysis) to support an on-site processing option will be included in a separate paragraph underneath this paragraph.
8	5.1, 4th Paragraph	110	EPA recommends deleting the 2nd sentence. The sentence tends to emphasis that the waste is characteristic and the UHCs apply. However, later in the paragraph, it is made clear that the detection limits from early sampling were above regulatory limits and that future sampling will address this issue. In fact, it is anticipated that future sampling will indicate that the concentration of contaminants of sludge in the V-tanks is below the regulatory limits.	**Resolved by Rick Farnsworth.** Comment partially accepted. The paragraph will be revised to identify that the current assumption (that the V-tank waste is characteristically hazardous) is a conservative one, primarily because the detection limits for many of the characteristically hazardous VOCs and SVOCs were above the regulatory limits in past analyses. The next sentence shall be changed to read that future sampling efforts may be pursued, using lower detection limits, to support the assumption that these trace contaminants are not present in the V-tank waste at characteristically hazardous levels. The next sentences shall be revised to state that if future sampling shows that the hazardous VOCs and SVOCs are below regulatory levels, then the V-tank waste will only require treatment of the listed and associated hazardous constituents in the tank (i.e., the F001 hazardous organics). Otherwise (if future sampling cannot be performed at lower detection levels, or the results of future sampling efforts support the presence of VOCs and SVOCs above regulatory levels), the V-tank sludge will be treated as characteristically hazardous, thereby requiring additional treatment of the full list of UHCs (to meet LDRs).

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
9	2nd Bullet	114	EPA does not agree that the material in the V-tanks is PCB liquids. The definition of PCB liquid is a homogeneous flowable material containing PCB and no more than 0.5% by weight dissolved material (CFR 761.3). Instead the material in the tanks more clearly meets the definition of sludge. Accordingly, EPA recommends that the CFR 761.61 (b)(2)(i) be the ARAR used in this ROD amendment, i.e. disposal in an approved landfill. ICDF has been approved for disposal of such PCB rememdiation waste by virtue of the Regional Administrators signature on the WAG-3 ROD.	**Resolved by Dave Eaton.** No change to document. While we agree that the material in the V-tank does not meet the definition of PCB liquid, it also does not meet the definition of non-liquid PCB remediation waste that is the subject of the suggested ARAR in the comment at 761.61(b)(2): "Any person disposing of non-liquid PCB remediation waste shall do so by one of the following methods: (i) Dispose of it in a high temperature incinerator approved under §761.70(b), an alternate disposal method approved under §761.60(e), a chemical waste landfill approved under §761.75, or in a facility with a coordinated approval issued under §761.77." The definition of non-liquid PCB remediation waste is based on the paint filter test, also found in 40CFR 761.3: "*Non-liquid PCBs* means materials containing PCBs that by visual inspection do not flow at room temperature (25 °C or 77 °F) or from which no liquid passes when a 100 g or 100 ml representative sample is placed in a mesh number 60 ± 5 percent paint filter, and allowed to drain at room temperature for 5 minutes." That points us to the essence of the problem. We have a multi-phase mixture of a liquid and non-liquid PCB remediation waste. PCB regulations do not specifically address this topic. EPA's TSCA program addressed this dichotomy by publishing a series of questions and answers that can be found on their web site at: http://www.epa.gov/pcb/qacombined.pdf Page 5 of this Q&A responds to the stated comment. ***"Q: How should a facility dispose of multi-phase waste if the highest PCB concentration is found in the solid phase of the waste? Can the waste be disposed of as a non-liquid even though there are liquids present in the waste?*** A: You may separate the waste into phases and dispose of it according to the disposal requirements applicable to each phase. You may also dispose of the waste without separation, based on the phase with the highest PCB concentration. For this example, 40 CFR 761.1(b)(4)(iv) allows disposal of the multi-phasic mixture based on the PCB concentration of the non-liquid phase; however, this section does not override the prohibition on disposing of PCB

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
9 (cont.)	2nd Bullet	114		liquids > 50 ppm in a landfill (§761.60(a)). If you choose to incinerate the multi-phasic waste, the incinerator must be approved to dispose of liquid PCBs. Section 761.50(a)(2) prohibits the processing of liquid PCBs into nonliquid forms to circumvent the high temperature incineration requirements of §761.60(a). If you would like to stabilize the sludge or solidify the sludge at a chemical waste landfill, you must obtain a 40 CFR 761.61(c) approval from the EPA Region."
10	Appendix A, Table A-3	A-7	Table A-3, indicates TCE and PCE as non key analytes, but Section A4.1 on Page A-8, Identification of Key Analytes In the Feed, includes these two constituents.	**Resolved by Rick Farnsworth.** For information only, as this comment refers to the Pre-Conceptual Design Report. There is no need to revise this report, since it is not part of the Administrative Record. Nevertheless, TCE (trichloroethylene) and PCE (tetrachloroethylene) are included in Table A-3 as key analytes. The callout for total VOCs, other than TCE and PCE, refers to other VOCs that are not specifically called out in this table, such as 1,1,1-trichloroethane.
11	Appendix B, 1st Complete paragraph	B-4	The uncertainty for the assumption of the degree freedom D_e =100 was not analyzed or discussed.	**Resolved by Rick Farnsworth.** For information only, as this comment refers to the Pre-Conceptual Design Report. There is no need to revise this report, since it is not part of the Administrative Record. The assumption of a Degree of Freedom of 100, for the stick measurement, was assumed, in order to provide some degree of freedom to the overall calculation of error, which was necessary to adequately design the robustness of each evaluated technology. A Degree of Freedom equivalent to 100, for the stick measurement, effectively assumes that the ± 1 in. confidence in the stick measurements is almost exact, and should be included in the error calculation without any further fudge factors, to determine the 95% confidence level.

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12	Appendix C	C-2	The basis of the "divide-by-20" rule was not discussed. If it was done to reconcile the fact that the protocol for TCLP requires the addition of 20L of extraction fluid per kilogram of soil, then a more appropriate rule (assuming a linear adsorption isotherm) would be (see Mohsen et al. 1997[3]) $c_w = \dfrac{c_t}{c_t / c^{TCLP} - 20/\rho_w}$ where c_w = constituent concentration in the liquid phase of the sample (mg/L) c_t = total concentration of the constituent in the sample (mg/kg) c^{TCLP} = TCLP concentration in the extract (mg/L), and ρ_w = density of water (gm/mL) The departure from the "divide-by-20" rule from the value computed by the above- mentioned formula can be significant, depending on the adsorption characteristics of the constituent.	**Resolved by Dave Tyson.** For information only, as this comment refers to the Pre-Conceptual Design Report. . There is no need to revise this report, since it is not part of the Administrative Record. The basis for the "divide by 20" rule is indeed to account for the 20L of TCLP extraction fluid per kg of solid. The proposed final waste forms are glass (VIT), dried solids (TD), or dry portland cement forms (CO/S). As a result, there is no c_w term (constituent concentration in the liquid phase of the sample). There is only the c^{TCLP} value for the final waste form, which can be conservatively estimated by the "divide by 20" rule applied to the total metal of interest in the waste form. The material balances that are presented only account for total concentrations of constituent in a given residue from a process - this approach provides useful information for processes involving separation/extraction and organic destruction. The amount of metals in a dried solid waste form can be reported, but the toxicity measure (leachability) cannot, except for this conservative rule-of-thumb. Obviously the heavy metals in either the glass form, the calcined solids, or the cement forms are considered fairly insoluble – it is up to the various authors to quantify the estimated amount of leachability reduction that is realized by the final waste form.
13	Appendix C		Detailed Mass Balance Sheets, Item 9 of EX-SITU CO/S: To be consistent CFT should be used instead of COC. On the same page, it is also not clear why steps 28, 29, and 30 are mentioned on the 4th assumption. On the same page it is confusing why the process step numbers start at C and then at 5.	**To be resolved by Rick Farnsworth.** For information only, as this comment refers to the Pre-Conceptual Design Report. There is no need to revise this report, since it is not part of the Administrative Record. The comment is correct, with regards to CFTs instead of COCs. The steps identified in the Assumptions portion of these spreadsheets should refer to steps 6, 7 and 8, for all CFTs. The same correction on steps should be made for the TCE, PCE, VOC &BEHP, Arochlor, and SVOC and TOC destruction assumptions, on all of the Assumption spreadsheets that follow the process flow diagram for EX-CO/S, regardless of what number is currently identified. The process steps referred to on these spreadsheet pages are directly tied to the process steps identified on the process diagram, which is placed in front of these sheets. The reason for the process spreadsheets starting at "C", then moving to "5", is in accordance with the specific aspects of the process flow diagram for EX-CO/S.

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DATE: 01/07/03 **REVIEWER:** EPA

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14	Appendix H	H-1	Two citations (Shaw, 1998 the 1st Paragraph, and Balazs et al., 1998 the 2nd Paragraph) and not in this document's reference list as such, these reviewers could not evaluate the implications of the citations included.	**Resolved by Rick Farnsworth.** We apologize for not providing these documents to you in time for your review. You should have them now. Please provide additional comments, after looking at them, if you desire. It should be remembered, however, that the proposed remediation strategies outlined in the Pre-Conceptual Design report were prepared to evaluate various technologies (i.e., chemical oxidation, vitrification and thermal desorption) against each other. Therefore, technological details discussed in the Pre-Conceptual Design report may be changed during Conceptual Design, as more is known of possible oxidants/reductants that may be used.
15	Appendix H, 4th Paragraph	H-2	No fall back plan is discussed if future treatability studies indicate lack of removal efficiency.	**Resolved by Rick Farnsworth.** For information only, as this comment refers to the Preconceptual Design Report. There is no need to revise this report, since it is not part of the Administrative Record. As previously described, the proposed remediation strategy outlined in the Pre-Conceptual Design report was for the purpose of evaluating CO/S against the other technologies (i.e., vitrification and thermal desorption). The current Conceptual Design effort for the "Ex Situ Chemical Oxidation/Reduction, with Stabilization" strategy is expected to include fall back plans for treatment of VOCs and BEHP (in the event that BEHP cleanup is required to LDR levels, which may not be necessary, if the V-tank wastes are found to not be characteristically hazardous). A part of the Conceptual Design effort includes further Chemical Oxidation treatability studies, aimed at defining the potential destruction of BEHP by peroxydisulfate, or the other chemical oxidants/reductants that may be used in the actual remediation effort.
			[1] Volatile Organic Analytes [2] Polynuclear Aromatic Hydrocarbons [3] M. F. N. Mohsen and R. Page, "Estimating Leachate Concentration form Extraction Test Results", Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection, and Remediation Conference and Exposition, Houston, Texas, November 12-14, 1997	

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PROJECT DOCUMENT REVIEW RECORD

DOCUMENT TITLE/DESCRIPTION: The Technology Evaluation Report for the V-tanks, TSF-09/18 at Waste Area Group 1, Operable Unit 1-10 (Draft), DOE/ID-11038, November 2002

DATE: 12/31/02 **REVIEWER:** IDEQ

ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
SPECIFIC COMMENTS				
1	Acronyms	xiv	Please consider the addition of the acronym, "BEHP" to this list for clarification to a reader unfamiliar with the compound discussed throughout the latter text sections.	**Resolved by Rick Farnsworth.** Comment accepted.
2	1.2.2, 1st Bullet	5	This statement gives the impression that there may be V -tanks waste ready for shipment to the ICDF in July 2003. The sentence should be reworded to indicate that the ICDF is projected for opening in July 2003 and will be available to receive V-tanks wastes in 2005, when the remedial action is projected to take place.	**Resolved by Rick Farnsworth.** Comment accepted.
3	3.6, Partial paragraph, top of page	42	Please briefly explain what is meant by "*compliance will be achieved* for VOCs through further processing and stabilization". How will compliance be determined?	**Resolved by Eric Miller and Dale Cresap.** Comment accepted. In this section, "compliance" means compliance of the GAC filter, following macroencapsulation, to the ICDF WAC limit of 500 ppm total VOCs. The strategy of pre-treating and sampling at lower temperatures, prior to process completion, is to ensure that the amount of undestroyed VOCs expected to volatilized to the GAC filter, will not exceed the 500 ppm total VOCs limit (after macro-encapsulation) that would allow for its disposal at the ICDF. As noted in the subject report, this so-called "pre-compliance" step will be done through solution sampling and analysis for VOCs. The pre-compliance step will be used to determine if additional oxidant/reductant addition is needed, prior to heating the tank sludge (to enhance the effects of the chemical oxidant/reductant). The paragraph will be re-written to better understand this. However, it should be mentioned that the proposed process was selected for the purposes of convenience in evaluating CO/S against the other technologies (i.e., vitrification and thermal desorption), as part of the Preconceptual Design effort. The current Conceptual Design effort shall finalize the actual oxidant/reductant, its method of addition, and whether or not heating is required.

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DATE: 12/31/02 **REVIEWER:** **IDEQ**

ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
4	3.7, 2nd Paragraph	45	Please describe the solidification phase in more detail. Please state if the ex-situ reactor vessel will become part of the solidification, or if the treated tank contents be transferred from the ex-situ reactor vessel to another container for solidification and eventual disposal.	**Resolved by Eric Miller and Dale Cresap.** Comment accepted. The current plan is that the treated waste from the reactor will be pumped to a mixer/extruder, where it will be stabilized with grout (or other stabilization materials. The stabilized material will then be containerized in 55 gallon drums for eventual disposal at the ICDF (see Figure 11 of the TER, for reference to mixer/extruder). Following treatment of all V-tank wastes, the reaction vessel will then, itself, be grouted and disposed of in the ICDF. This information shall be added to Section 3.7 of the TER.
5	4.1, 2nd Bullet	48	The cost estimators evaluated the costs for the varying alternatives at the pre-conceptual level, which are stated to be within the range of "+50/-30%". The "+50%" value seems very high, compared to the dollar values discussed for all of the alternatives, especially considering the leading alternative selected (ES-CO/S). Please offer a base-of-reference on whether this value is at or near an industry standard for this point in time for a project, and when a more precise cost estimate could be expected.	**Resolved by Bruce Wallace.** This range is provided to us from EPA as the range required for project completion before an ESD would be required. This range is applicable to feasibility study level estimates, which is the level used in the Technology Evaluation Report. The total project completion costs will be evaluated against this criterion, but it is not a consideration in the preparation of the estimate. We have performed a planning level "bottoms up" estimate including escalation, risk evaluation and contingency application. It is expected that the total project cost will comply with EPA's +50/-30% range. A sentence shall be added to the bullet explaining that the "+50%/-30%" range complies with the EPA requirements, regarding the range outside of which an ESD would be required.
6	4.3.1, Figures 23 and 24	57 and 58	Even though the information is provided in the text, Figure 23 would benefit with the addition of an entry at the commencement of the Time (years) axis indicating the starting point such as, "Amended ROD Approval". Figure 24 would also benefit from this same addition. Also, please add the label "Years" to the time axis for Figure 24.	**Resolved by Rick Farnsworth.** Comment accepted. The term "(after Amended ROD Approval)" shall be added to the headings of these two figures.
7	4.9, Table 17	78	This is an excellent Table, which graphically and eloquently illustrates the relationships between tile varying alternatives. One suggestion for the sake of consistency and reading ease would be to align the "Alternative Number" entries to the corresponding "Alternative", similar to the first page of this Table (page 77).	**Resolved by Rick Farnsworth.** Comment accepted. Thanks for the kudos.
8	Ibid	79	As in the prior comment, please space out the "Alternative Number" entries to match those in the "Alternative" column.	**Resolved by Rick Farnsworth.** Comment accepted.

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ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
9	4.9, Table 17	85	As in the comment previously provided for Figure 24 of Section 4.3.1, please consider the addition of the "Amended ROD Approval" and "Years" labels to this chart.	**Resolved by Rick Farnsworth.** Comment accepted. The "Years" label shall be added to the Figure on page 86, as well as page 85. In addition, the term "(after Amended Rod Approval)" shall be added to the headings of these two figures.
10	4.9, Table 17	86	Same comment (as above) for the chart on this page.	**Resolved by Rick Farnsworth.** Comment accepted. The "Years" label shall be added to the Figure on page 86, as well as page 85. In addition, the term "(after Amended Rod Approval)" shall be added to the headings of these two figures.
11	5.1, Figure 45	110	It is not clear what the basis for the information provided in this Figure is, and what the percentages (vertical axis) indicate. Please explain.	**Resolved by Rick Farnsworth.** Comment accepted. Figure 45 simply refers to the deviation from the average value rating that was recorded for each of the seven prospective V-tank remediation technologies. The Figure shows that all but one of the seven proposed technologies (the "Thermal Desorption, Off-Site Treatment and Disposal" option) were above the average value rating, with only slight differences,. In contrast, the "Thermal Desorption, Off-Site Treatment and Disposal" option was significantly below the average value rating, as well as significantly below the values of the other six technologies that were proposed. This information shall be included in the revised Technology Evaluation Document.

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DATE: 12/31/02 **REVIEWER:** **IDEQ**

ITEM NUMBER	SECTION NUMBER	PAGE NUMBER	COMMENT	RESOLUTION
12	5.1, Bottom paragraph, Last complete sentence	110	An addition to this sentence, it would help the reader realize that, at the time of sampling and analyses in previous years, the detection limits for the VOCs and SVOCs were above the regulatory limits, and therefore, the more conservative position is taken today unless analytically demonstrated to be otherwise.	**Resolved by Rick Farnsworth.** Comment partially accepted. The paragraph will be revised to identify that the current assumption (that the V-tank waste is characteristically hazardous) is a conservative one, primarily because the detection limits for many of the characteristically hazardous VOCs and SVOCs were above the regulatory limits in past analyses. The next sentence shall be changed to read that future sampling efforts may be pursued, using lower detection limits, to support the assumption that these trace contaminants are not present in the V-tank waste at characteristically hazardous levels. The next sentences shall be revised to state that if future sampling shows that the hazardous VOCs and SVOCs are below regulatory levels, then the V-tank waste will only require treatment of the listed and associated hazardous constituents in the tank (i.e., the F001 hazardous organics). Otherwise (if future sampling cannot be performed at lower detection levels, or the results of future sampling efforts support the presence of VOCs and SVOCs above regulatory levels), the V-tank sludge will be treated as characteristically hazardous, thereby requiring additional treatment of the full list of UHCs (to meet LDRs).
13	5.2.1, Entire section	113 and 114	The four concepts enumerated within this Section are succinctly and very well stated. The positions taken for each bullet are those that were discussed at length between the Agencies in Idaho Falls, Idaho on October 23rd and 24th, 2002. The issues presented adequately reflect the consensus of the Agencies for the resolution of these regulatory challenges.	**Resolved by Rick Farnsworth.** No change required to the document. Thanks for the kudos.
14	6.1, 1st Paragraph	115	It is unclear in this section whether the Proposed Plan is drafted and put out for public comment and subsequently a ROD Amendment is drafted and sent out for public comment later as well. The fourth last bullet implies that this might be the case, but it is hard to follow. Please clarify if this is a combined document for public comment or two separate, subsequent actions. Table 19 seems to imply that these are separate events, although no public comment period is mentioned for the ROD Amendment entry.	**Resolved by Rick Farnsworth.** Comment accepted. The paragraph shall be revised to show a chronological sequence, between submittal of the Proposed Plan Amendment, and finalization of the ROD Amendment. The Proposed Plan Amendment and ROD Amendment are two separate documents. However, only the Proposed Plan Amendment requires a public comment period. The ROD Amendment will incorporate the responses from the public comment period on the Proposed Plan Amendment, and use them to assist in the final ROD Amendment determination, as to which technology should be selected.